UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southwest Region
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MAR 27 2000 F/SWO3:GRS

Lowell Ploss, Operations Manager
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Steve Macaulay
California Department of Water Resources
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Dear Messrs. Ploss and Macaulay:

Enclosed is a final biological opinion prepared by the National Marine Fisheries Service (NMFS) for the proposed operation of the Central Valley Project (CVP) and State Water Project (SWP) during the period between December 1999, and March 2000, and its effects on Federally threatened Central Valley steelhead and threatened Central Valley spring-run chinook salmon pursuant to section 7 of the Endangered Species Act. The biological opinion was based on information provided in your letters of January 29, 1999; August, 25, 1999; September 17, 1999; the January 1999 biological assessment and project description; and the October 1999 operations forecast (dated November 3, 1999).

Based on the best available scientific information, the biological opinion concludes that the proposed operations of the CVP and SWP between December 1999 and March 2000 are not likely to jeopardize the continued existence of Central Valley spring-run chinook or Central Valley steelhead, or result in the destruction or adverse modification of proposed critical habitat for these species. However, some incidental take of steelhead and spring-run chinook salmon is anticipated. Authorized take levels for spring-run chinook and steelhead are specified in the incidental take statement attached to the final biological opinion. Incidental take is expected to remain within authorized levels provided the Bureau of Reclamation and the Department of Water Resources (DWR) fully comply with the proposed CALFED Operations Group Spring-run Chinook Protection Plan and the planned use of CVPIA Section 3406 (b)(2) water for Delta fish protection during December, January, and February.

NMFS recognizes that flexibility in scheduling CVP and SWP operations is necessary to maximize benefits to both fisheries and water supply. My staff is prepared to continue to work cooperatively with Reclamation, DWR, and the other CALFED agencies to monitor current hydrological conditions and biological data for timely implementation of fisheries protective measures and ensure authorized incidental take levels are not exceeded.

Consultation must be reinitiated if (1) the amount or extent of taking specified in the incidental take statement is exceeded, or is expected to be exceeded; (2) new information reveals effects of the action may affect listed species in a way not previously considered; (3) the action is modified in a way that causes an effect on listed species that was not previously considered; (4) a new species is listed or critical habitat is designated that may be affected by the action (50 CFR § 402.16).

To address the period following April 1, 2000, my staff has initiated discussions with Reclamation and DWR regarding additional information needs and a process for extending this biological opinion through March 31, 2001. The CVP and SWP operational forecasts dated March 20, 2000, for the period of April 2000, through February 2001, have been provided to my staff and a preliminary assessment of potential impacts has been initiated. In coordination with the CALFED Operations Group and the CVPIA B2 Interagency Team, I look forward to continuing to work with Reclamation and DWR to address CVP and SWP operations.

If you have any questions concerning the enclosed biological opinion, please contact Gary Stern at 707-575-6060.

Sincerely,

Rodney R. McInnis

Rodney R. McInnis
Acting Regional Administrator

cc: Wayne White, FWS
Ryan Broddrick, DFG

BIOLOGICAL OPINION

Agency: U.S. Bureau of Reclamation and the California Department of Water Resources

Activities: Operation of the Federal Central Valley Project and the California State Water Project from December 1, 1999 through March 31, 2000

Consultation Conducted By: National Marine Fisheries Service/Southwest Region

Date Issued: MAR 27 2000

I. CONSULTATION HISTORY

Informal discussions began in May 1998, between the U.S. Bureau of Reclamation (Reclamation), the California Department of Water Resources (DWR), and the National Marine Fisheries Service (NMFS) regarding the need for an Endangered Species Act (ESA) consultation on the effects of the Central Valley Project (CVP) and State Water Project (SWP) operations on the Federally threatened Central Valley steelhead. On May 26, 1998, Reclamation confirmed by letter to NMFS that informal consultation regarding the potential effects of CVP operations on Central Valley steelhead had been initiated. In September 1998, the agencies agreed to expand the consultation to include a conference on the Federally proposed endangered Central Valley spring-run chinook salmon pursuant to the ESA. Concurrently, the agencies agreed that the California Department of Fish and Game (DFG) should participate and combine this consultation/conference with the California Endangered Species Act (CESA) incidental take permit procedures for the State listed threatened Central Valley spring-run chinook salmon.

Due to the uncertainty associated with the forthcoming CALFED Program Record of Decision in mid-2000 and the need to expedite the issuance of a CESA incidental take permit, the agencies agreed to limit the scope of this consultation to operation of the CVP and SWP during the period between October 1998 and March 2000. Reclamation's facilities to be addressed in this interim consultation include all CVP units, except the Friant Division and Lewiston Dam of the Trinity River Division. DWR's facilities to be addressed in this interim consultation include the following: Oroville-Thermalito Complex, Harvey O. Banks Delta Pumping Plant, Clifton Court Forebay, Skinner Fish Protective Facility, Northbay Aqueduct, and the Suisun Marsh Salinity Control Structure. Facilities and operations of CVP and SWP contractors are not addressed in this consultation and, thus, are not provided authorization for incidental take through this consultation. In addition, the agencies recognized that formal consultation regarding CVP and SWP operations beyond March 31, 2000 would need to occur in the near future and it was acknowledged that the long-term operations of these same facilities should be conducted subsequent to the completion of this interim consultation.

Regularly scheduled meetings between NMFS, DFG, DWR, and Reclamation were initiated in September 1998. Biologists with the U.S. Fish and Wildlife Service (FWS) participated intermittently to ensure proper coordination with implementation of the Anadromous Fish Restoration Program (AFRP) of the Central Valley Project Improvement Act (CVPIA). An initial project description was included in a draft biological assessment (BA) entitled, "Effects of the Central Valley Project and State Water Project Operations from October 1998 through March 2000 on Steelhead and Spring-run Chinook Salmon" which was provided to NMFS and DFG for review and comment on November 9, 1998. The DFG and NMFS provided comments regarding the draft BA on November 30, 1998, and December 8, 1998, respectively. At this time, NMFS and DFG also requested that Reclamation and DWR conduct additional modeling of alternative reservoir operations (i.e., model various flow releases in conjunction with temperature control device operations, where available; and model the resulting water temperatures associated with these alternative reservoir operations) and conduct additional analysis regarding the effects of Sacramento-San Joaquin Delta (Delta) water export operations on spring-run chinook salmon smolt survival rates through the Delta. Concurrently, DFG conducted their own analysis of the effects of CVP/SWP Delta operations on the survival of spring-run chinook salmon smolts. DFG spring-run chinook salmon models and analysis were presented and discussed during a series of meetings and telephone conferences beginning on December 23, 1998, and continuing through March 8, 1999.

In response to NMFS' and DFG's request for alternative reservoir operations, Reclamation and DWR modeled alternative scenarios to proposed CVP and SWP reservoir and water management operations that were designed to improve flows and water temperature conditions for steelhead and spring-run chinook salmon (where present). These alternative operational scenarios to improve flows and water temperatures for steelhead and spring-run chinook salmon were presented and discussed on December 23, 1998 (Oroville Reservoir on the Feather River); January 20, 1999 (new Melones Reservoir on the Stanislaus River); January 29, 1999 (Folsom Reservoir on the American River); and February 3, 1999 (Whiskeytown Reservoir on Clear Creek). The role of the American River Operations Group in relation to water management on the American River was also discussed on January 29, 1999.

While these meetings and discussions were being conducted, the Reclamation and DWR provided NMFS a final BA and requested initiation of formal section 7 consultation on January 29, 1999, regarding their respective Water Year 1999 (i.e., October 1998 through September 1999) through March 2000 operations (DWR and Reclamation 1999). In addition, on February 11, 1999, the Reclamation requested that NMFS concur with their determination that forecasted 1999 operations would be consistent with the NMFS' winter-run chinook salmon biological opinion (WR Opinion) issued on February 12, 1993, subsequently amended on August 2, 1993, October 6, 1993, December 30, 1994, May 13, 1995, and August 18, 1995 (WR Opinion). By letter dated February 18, 1999, NMFS informed Reclamation that the proposed allocations for Water Year 1999 were consistent with the WR Opinion and that measures under development by NMFS to protect steelhead and spring-run chinook in the ongoing consultation should not impact the proposed water allocation.

In April 1999, NMFS initiated the drafting of a biological opinion. However, due to hydrological updates and unforeseen circumstances, proposed CVP/SWP operations changed several times after the original January 29, 1999, proposal was submitted to NMFS. During May and June 1999, Delta export curtailments to protect the threatened Delta smelt required rescheduling of some CVP and SWP pumping. In July 1999, DWR requested and was granted permission by the U.S. Army Corps of Engineers to increase diversion rates into Clifton Court Forebay by up to 500 cfs during August and September 1999. On August 25, 1999, Reclamation submitted additional information to NMFS regarding actions to manage the entrainment of mitten crabs at the CVP's Tracy Fish Collection Facility and the SWP's Skinner Fish Protective Facility. Reclamation and DWR described their temporary structural modifications designed to intercept, divert, or prevent mitten crabs from entering the Delta fish collection facilities during the fall of 1999 in a report documenting the results of a model study and evaluation plan (Reclamation 1999) and in a California Environmental Quality Act Notice of Exemption (DWR 1999), respectively. On October 6, 1999, Reclamation and FWS released the Final Decision on Implementation of Section 3406(b)(2) of the CVPIA (October 6, 1999, Final Decision). This decision set forth an accounting system and a process for developing and implementing fisheries protection measures with (b)(2) water. On November 5, 1999, Reclamation requested approval from the State Water Resources Control Board (SWRCB) for authorization to use the SWP's Banks Pumping Plant as a point of diversion for the CVP during November 1999. On November 12, 1999, the SWRCB approved Reclamation's request subject to terms and conditions established by DFG and submission of certain reports and information.

During the late spring, summer, and fall of 1999, water supply forecasts and CVP/SWP operational updates were provided monthly to NMFS through the CALFED Operations Group and its sub-groups (i.e. the No Name Group and Data Assessment Team).
Throughout this period, Reclamation, DWR, DFG , and NMFS continued discussions to clarify the project description and to evaluate operational alternatives. NMFS also actively participated in the interagency team of project operators and agency biologists established to assist the Department of Interior implement annual actions to dedicate and manage (b)(2) water (B2 Interagency Team).

Since the biological opinion was not issued by June and management of summer water temperature conditions in streams below CVP and SWP facilities were a primary subject of this consultation, NMFS issued draft fisheries objectives for the Stanislaus River, Feather River, Clear Creek, and American River on July 14, 1999, to Reclamation and DWR. These temperature and flow objectives for the protection of juvenile Central Valley steelhead and spawning Central Valley spring-run chinook salmon were developed, modeled, and discussed in consultation with Reclamation, DWR, DFG and FWS. Additional information regarding the management of Clear Creek flows for spawning spring-run chinook salmon was provided by NMFS to Reclamation by letter dated September 14, 1999. These fisheries objectives were generally met by Reclamation on Clear Creek, the American River, and the Stanislaus River. Reclamation acquired approximately 50,000 acre feet (AF) of water on the Stanislaus River to augment summer base flows and achieve the temperature objective established for steelhead during July, August, and September of 1999. On the Feather River, DWR made no operational modifications from their base operation and the temperature objectives requested by NMFS were not achieved. DWR explained their inability to comply with these objectives for the Feather River/Oroville complex to NMFS by letter dated September 14, 1999.

On September 16, 1999, NMFS issued a final rule designating Central Valley spring-run chinook salmon as "threatened" under the ESA. In response to this listing, Reclamation requested by letter dated September 17, 1999, that the forthcoming draft conference opinion for Central Valley spring-run chinook salmon be converted into a biological opinion.

On November 22, 1999, Reclamation provided supplemental information regarding DWR's program to mitigate the impacts of SWP operations in the Delta. This supplemental information package included an estimate of direct and indirect losses of spring-run chinook salmon smolts in the Delta from 1996 through 1998 and predicted annual spring-run chinook benefits in smolt equivalents from four projects that have been totally or partly funded by DWR through the 4-Pumps Mitigation Agreement[1].

On November 4, 1999, Reclamation and FWS presented a public workshop on CVPIA (b)(2) Implementation, Coordination/Consultation Process, and Water Supply Actions. During this presentation, Reclamation provided a summary of potential (b)(2) fish actions and an operations forecasts for the October 1999 through September 2000 Water Year. Based on new information provided in this October forecast, NMFS, Reclamation, and DWR agreed in a November 30, 1999, meeting to limit the scope of this consultation to December 1999 through March 2000.

II. DESCRIPTION OF PROPOSED ACTION

Description of Central Valley Project Facilities Upstream of the Delta

General descriptions of the CVP and associated facilities are discussed in this section and are provided for background information only. Specific operations of the CVP and SWP are described in the section entitled "Description of the Proposed Operations of the Central Valley Project Facilities from December 1999 through March 2000".

<u>Trinity River Division</u>

The Trinity River Division, completed in 1964, includes facilities to store and regulate water in the Trinity River, as well as facilities to divert water to the Sacramento River Basin. The main facilities of the division include the Trinity Dam and Powerplant; Trinity Reservoir (2,448,000

[1]DFG disagrees with specific assumptions and calculations DWR used in its analysis, but concurs with the conclusion, based on DFG analysis using more current information, that for the period covered by this biological opinion there are three of these projects that are currently being implemented which provide benefits that are likely to mitigate both direct and indirect effects to spring-run chinook salmon caused by SWP operations.

AF capacity); Lewiston Dam, Lake, and Powerplant; Clear Creek Tunnel; Judge Francis Carr Powerhouse; Whiskeytown Dam and Lake (241,000 AF capacity); Spring Creek Tunnel and Powerplant; and Spring Creek Debris Dam and Reservoir (5,800 AF capacity).

Trinity Reservoir releases are re-regulated downstream at Lewiston Dam and Lake to meet downstream flow, in-basin diversion, and downstream temperature requirements. Lewiston Lake also provides a forebay for the trans-basin diversion of flows through the Clear Creek Tunnel and the Judge Francis Carr Powerhouse into Whiskeytown Lake on Clear Creek.

Water stored in Whiskeytown Lake includes exports from the Trinity River as well as runoff from the Clear Creek drainage. A majority of the water released from Whiskeytown Lake travels through the Spring Creek Tunnel and Powerplant and is discharged into Keswick Reservoir on the Sacramento River. A small amount of water from the lake is also released through the Whiskeytown Dam outlet works and the City of Redding Powerplant into Clear Creek which flows into the Sacramento River below Keswick Dam.

The Spring Creek Debris Dam is also a feature of the Trinity River Division of the CVP. It was constructed in 1963 to regulate runoff containing acid mine drainage from Iron Mountain Mine in the Spring Creek watershed. The Spring Creek Debris Dam can store up to approximately 5,800 AF of water. Runoff containing acid mine drainage from several inactive copper mines and exposed ore bodies at Iron Mountain Mine is stored in Spring Creek Reservoir. Since 1990 concentrations of toxic metals in acidic drainage from Iron Mountain Mine has progressively decreased due to several remedial actions including the construction and operation of a lime neutralization plant. Operation of the Spring Creek Debris Dam and Shasta Dam has allowed some control of the toxic wastes with dilution criteria.

Sacramento River Division

The Sacramento River Division of the CVP includes facilities for the diversion and conveyance of water to CVP contractors on the west side of the Sacramento River. At Red Bluff, the Sacramento Canals Unit of the Sacramento River Division includes the Red Bluff Diversion Dam, the Corning Pumping Plant, and the Corning and Tehama-Colusa canals. These facilities provide for diversion and conveyance of irrigation water to over 200,000 acres of land in the Sacramento Valley, principally in Tehama, Glenn, Colusa, and Yolo counties. The Sacramento River Division also includes Black Butte Dam and Lake. Black Butte Dam and Lake were integrated into the CVP in 1970. The facilities are operated jointly by the Army Corps of Engineers and Reclamation to provide for flood control and for irrigation water supplies, respectively. Black Butte Reservoir provides supplemental water to the Tehama-Colusa Canal as it crosses Stony Creek.

Shasta Division

The Shasta Division of the CVP includes facilities that conserve water on the Sacramento River for flood control, navigation maintenance, conservation of fish in the Sacramento River, protection of the Sacramento-San Joaquin Delta from intrusion of saline ocean water, agricultural water supplies, municipal and industrial (M&I) water supplies, and hydroelectric generation. The Shasta Division includes Shasta Dam, Lake, and Powerplant; Keswick Dam, Reservoir, and Powerplant; and the Toyon Pipeline. Shasta Dam and Lake (4,552,000 AF capacity) is the largest storage reservoir on the Sacramento River. Completed in 1945, Shasta Dam controls floodwater and stores winter runoff for various uses in the Sacramento and San Joaquin valleys. Keswick Dam, located approximately 9 miles downstream from Shasta Dam creates an afterbay (23,000 AF capacity) for Shasta Lake and Trinity River diversions. Keswick Dam and Reservoir stabilizes the peak hydroelectric operation water releases from Spring Creek and Shasta Powerplants. Anadromous fish trapping facilities at Keswick Dam are operated in conjunction with the FWS. Some of the salmon trapped at the Keswick fish trap are taken for use as broodstock at the Coleman National Fish Hatchery approximately 25 miles downstream of Keswick Dam on Battle Creek, tributary to the Sacramento River.

Construction of a temperature control device (TCD) at Shasta Dam was completed in 1997. This device is designed to selectively withdraw water from elevations with Shasta Lake while enabling hydroelectric power generation. The TCD allows greater flexibility in the management of cold water reserves in Shasta Lake for maintenance of adequate water temperatures in the Sacramento River downstream of Keswick Dam.

Approximately 5 miles downstream of Keswick Dam, the Anderson-Cottonwood Irrigation District (ACID) has been diverting water for irrigation from the Sacramento River since 1916. The ACID diversion dam and canal operate seasonally from the spring through fall of each year to deliver irrigation water supplies along the westside of the Sacramento River between Redding and Cottonwood. A contractual agreement between the Federal Government and ACID provides for diversion of water and requires Reclamation to reduce Keswick Dam releases to accommodate the installation, removal, or adjustment of boards associated with the ACID diversion dam.

American River Division

The American River Division includes the Folsom Unit, Sly Park Unit, and Auburn-Folsom South Unit of the CVP. These facilities conserve water on the American River for flood control, fish and wildlife protection, recreation, protection of the Sacramento-San Joaquin Delta from intrusion of saline ocean water, agricultural water supplies, municipal and industrial (M&I) water supplies, and hydroelectric generation. The Folsom Unit consists of Folsom Dam and Lake (977,000 AF capacity), Folsom Powerhouse, Nimbus Dam, Lake Natoma, and Nimbus Powerplant on the American River. The Sly Park Unit which provides water from the Consumnes River to El Dorado Irrigation District (EID) includes Jenkinson Lake formed by Sly Park Dam on Sly Park Creek, a low concrete diversion dam on Camp Creek, and Sly Park Conduit. The Folsom and Sly Park Units were added to the CVP in 1949. In 1965, the Auburn-Folsom South Unit was authorized and includes County Line Dam, Pumping Plant, and

Reservoir; Sugar Pine Dam and Reservoir; Linden and Morman Island Pumping Plants; Folsom South Canal; and other necessary diversion works, conduits, and appurtenant works for delivery of water supplies to Placer, El Dorado, Sacramento, and San Joaquin counties.

Although Folsom Lake is the main storage and flood control reservoir on the American River, numerous other small reservoirs in the upper basin provide generation and water supply. None of the upstream reservoirs have specific flood control responsibilities. The total upstream storage above Folsom lake is approximately 820,000 AF. Ninety percent of this upstream storage is contained by five reservoirs: French Meadows; Hell Hole (208,000 af); Loon Lake (76,000 af); Union Valley (271,000 af) and Ice House (46,000 af). French Meadows and Hell Hole reservoirs, located on the Middle Fork of the American River are owned and operated by Placer County Water Agency. (PCWA). PCWA provides wholesale water to agricultural and urban areas within Placer County. Loon Lake on the Middle Fork, and Union Valley and Ice House reservoirs on the South Fork of the American River are operated by Sacramento Municipal Utilities District (SMUD).

<u>Eastside Division</u>

The New Melones Unit of the Eastside Division includes facilities that conserve water on the Stanislaus River for flood control, fish and wildlife protection, bay-delta flow requirements, dissolved oxygen requirements, Vernalis water quality, agricultural water supplies, municipal and industrial (M&I) water supplies, and hydroelectric generation. Facilities consists of New Melones Dam, Reservoir (2.4 million AF), and Powerplant. Other water storage facilities in the Stanislaus River include the Tri-Dam project, a hydroelectic generation project that consists of Donnells and Beardsley dams located upstream of New Melones on the middle fork Stanislaus River, and Tulloch Dam and Powerplant, located approximately six miles below New Melones Dam on the mainstem Stanislaus River. Releases from Donnells and Beardsley dams affect inflows to New Melones Reservoir. Under contractual agreements between Reclamation and the Oakdale Irrigation District (OID) and South San Joaquin Irrigation District (SSJID), Tulloch Reservoir provides afterbay storage to re-regulate power releases from New Melones Powerplant. Approximately 1.9 miles downstream of Tulloch Dam is Goodwin Dam and Reservoir. Goodwin Dam, constructed by OID and SSJID in 1912, creates a re-regulating reservoir for releases from Tulloch Powerplant. Goodwin Reservoir is the main water diversion point for the Stanislaus River and includes diversions through two canals running north and south of the Stanislaus River for delivery to OID and SSJID. Water impounded behind Goodwin Dam may also be pumped into the Goodwin Tunnel for deliveries to the Central San Joaquin Water Conservation District and the Stockton East Water District. Goodwin Reservoir also provides releases to the lower mainstem Stanislaus River.

Description of State Water Project Upstream Facilities

General descriptions of the SWP and associated facilities are discussed in this section and are provided for background information only. Specific operations of the SWP are described in the section entitled "Description of the Proposed Operations of the Central Valley Project Facilities During Water Year 1999 through March 2000."

Oroville-Thermalito Complex

The Oroville-Thermalito Complex of the SWP includes facilities that conserve water on the Feather River for power generation, flood control, recreation, and fish and wildlife protection. The Oroville-Thermalito Complex includes the following: Oroville Dam and Lake (3,538,000 AF capacity), and Edward-Hyatt Powerplant; Thermalito Diversion Dam, Power Canal, Diversion Pool, Diversion Dam Powerplant, Forebay and Afterbay; and Fish Barrier Dam (see Figure 4 in BA). A maximum of 17,000 cfs can be released from Oroville Dam through the Edward Hyatt Powerplant. Approximately four miles downstream from the Oroville Dam/Edward-Hyatt Powerplant is the Thermalito Diversion Dam. The Thermalito Diversion Dam creates the Thermalito Diversion Pool which acts as a water diversion point and includes diversions to the Thermalito Power Canal on the north side (majority of the flow; up to 17,000 cfs) and to the Feather River on the south side. This river section on the south side between the Thermalito Diversion Dam and the Thermalito Afterbay outlet is commonly referred to as the low flow channel. Flows are typically a constant 600 cfs through this 8-mile low flow channel except during periods when flood control releases from Oroville Lake are in effect. The Fish Barrier Dam at the upstream end of the low flow channel is an impassable barrier that diverts water for use by the DFG's Feather River Fish Hatchery.

The Thermalito Power Canal hydraulically links the Thermalito Diversion Pool to the Thermalito Forebay (11,768 AF capacity; offstream regulating reservoir for the Thermalito Powerplant); water diverted at the Thermalito Diversion Dam travels through the Thermalito Power Canal and empties into the Thermalito Forebay. Water from the Thermalito Forebay exits through the Thermalito Powerplant into the Thermalito Afterbay and is either used by diverters directly from the Afterbay or is released back into the Feather River approximately 8 miles downstream of its original diversion point. Thermalito Afterbay provides for local diversions that can take up to 4,050 cfs during peak demands. In addition, excess water conserved in storage within the Thermalito Afterbay can be used for pumpback operations through both the Thermalito and Edward-Hyatt Powerplants when economically feasible. The Thermalito Diversion Pool serves as a forebay when the Edward-Hyatt Powerplant is pumping water back into Lake Oroville.

Description of Central Valley Project and State Water Project Delta Facilities

General descriptions of the CVP and SWP's Delta facilities are discussed in this section and are provided for background information only. Specific operations of the CVP and SWP are described in the section entitled "Description of the Proposed Operations of the Central Valley Project Facilities During Water Year 1999 through March 2000."

The CVP and SWP use the Sacramento and San Joaquin Rivers and channels in the Delta to transport natural river flows and reservoir storage to two large water export facilities in the south

Delta. The CVP's Tracy Pumping Plant and the SWP's Harvey O. Banks Delta Pumping Plant (Banks Pumping Plant) are operated to meet the water supply needs in the San Joaquin Valley, southern California, central coast, and south San Francisco Bay area.

CVP Export Facilities and Associated Tracy Fish Collection Facility

The Tracy Pumping Plant, about five miles north of Tracy, California, consists of six pumps including one rated at 800 cfs, two at 850 cfs, and three at 950 cfs. Although the total plant capacity is about 5,300 cfs, the maximum permitted pumping capacity by the State Water Resources Control Board (SWRCB) is 4,600 cfs. The Tracy pumping plant is located at the end of an earth-lined intake channel about 2.5 miles long and pumps water from Old River into the Delta-Mendota Canal. A portion of the water conveyed through the Delta-Mendota Canal flows into the O'Neill Forebay and is lifted to the joint CVP/SWP San Luis Reservoir for storage.

At the head of the intake channel, the Tracy Fish Collection Facility is designed to intercept fish before they pass through the canal to the Tracy Pumping Plant. Fish are collected and transported by tanker truck to release sites away from the pumps. This facility uses behavioral barriers consisting of primary and secondary louvers to guide targeted fish into holding tanks. When compatible with export operations, the louvers are operated with the objective of achieving water approach velocities for striped bass of approximately one foot per second from May 15 through October 31 and for salmon of approximately three feet per second from November 1 through May 14. Channel velocity criteria are a function of bypass ratios through the facility. Hauling trucks are used to transport salvaged fish to release sites in the western Delta. The CVP maintains two permanent release sites: one on the Sacramento River near Horseshoe bend and the other on the San Joaquin River immediately upstream of Antioch Bridge.

SWP Export Facilities, Clifton Court Forebay, and Associated Skinner Fish Protection Facility

The Banks Pumping Plant, about eight miles northwest of Tracy, California in the south Delta, consists of 11 pumps, including two rated at 375 cfs, five at 1,130 cfs, and four at 1,067 cfs. Water is pumped from the Clifton Court Forebay (CCF) through the Banks Pumping Plant into the California Aqueduct which has a nominal capacity of 10,300 cfs. Average daily pumping at the Banks Pumping Plant is constrained by diversion limitations at CCF. Water in the California Aqueduct flows to O'Neill Forebay, from which a portion of the flow is lifted to the joint CVP/SWP San Luis Reservoir for storage. From O'Neill Forebay, the joint-use portion of the aqueduct, San Luis Canal, extends south to the southern end of the San Joaquin Valley. The SWP portion of the aqueduct continues over the Tehachapi Mountains to the South Coast Region.

The CCF is a regulated reservoir at the head of the California Aqueduct in the south Delta. Delta water inflows to the Forebay are controlled by radial gates, which are generally operated during the tidal cycle to reduce approach velocities, prevent scour in adjacent channels, and minimize water level fluctuation in the south Delta by taking water in through the gates at times other than

Suisun Marsh Salinity Control Gates

The Suisun Marsh Salinity Control Gates (SMSCG) are located about 2 miles northwest of the eastern end of Montezuma Slough, near Collinsville. The SMSCG which span the entire 465 foot width of Montezuma Slough include permanent barriers adjacent to the levee on each side of the channel, flashboards, radial gates, and a boat lock. The structure is typically operated from September through May to tidally pump lower salinity water from Collinsville through Montezuma Slough into the eastern and central portion of Suisun Marsh. The SMSCG also serve to retard the movement of higher salinity water from Grizzly Bay into the western marsh. During full gate operation, the SMSCG open and close twice each tidal day. During ebb tides, the gates are open to allow the normal flow of lower salinity water from the Sacramento River to enter Montezuma Slough. During flood tides, the gates are closed to retard the upstream movement of higher salinity water from Grizzly Bay.

Rock Slough

The Contra Costa Canal was built by Reclamation in 1948 and is currently operated by the Contra Costa Water District (CCWD). The Canal uses an unscreened intake facility at Rock Slough about four miles southeast of Oakley to divert water from the Delta for agricultural, municipal and industrial uses in central and northeastern Contra Costa County. The Rock Slough intake consists of four pumping plants that lift diverted water 127 feet into the Contra Costa Canal. This 47.7 mile long canal terminates into Martinez Reservoir. In addition, two short canals called Clayton and Ygnacio are integrated into the distribution system. Rock Slough has a diversion capacity of 350 cfs which gradually decreases to 22 cfs at the terminus.

Prior to 1997, Rock Slough was CCWD's primary diversion facility in the Delta and pumping ranged from 50 to 250 cfs with seasonal variation. In 1997, CCWD began additional diversions from the Delta at a new 250 cfs screened intake structure on Old River which is part of the recently completed Los Vaqueros Project. The Old River facility allows CCWD to directly divert up to 250 cfs of CVP water into an intertie with the existing Contra Costa Canal which allows for reduced diversion needs at Rock Slough. In addition, the Old River facility can divert up to 200 cfs of CVP and Los Vaqueros water rights for storage into the new 100,000 AF Los Vaqueros Reservoir.

Pursuant to the 1993 FWS delta smelt biological opinion for Los Vaqueros (Los Vaqueros Opinion), the Old River facility is now the primary diversion point for CCWD during January through August of each year. Additionally, according to the Los Vaqueros opinion and WR Opinion, CCWD is required to cease all diversions from the Delta for 30 days during the spring if stored water is available for use in Los Vaqueros above emergency storage levels. These operations criteria are designed to provide protection to Delta fisheries.

low tide. When a large head differential exists between the outside and inside of the gates, theoretical inflow can be as high as 15,000 cfs for a short period of time. However, existing operating procedures identify a maximum design rate of 12,000 cfs which prevents water velocities from exceeding three feet per second to control erosion and prevent damage to the facility.

In front of the Banks Pumping Plant, the Skinner Fish Protection Facility (SFPF) intercepts fish which are collected and transported by tanker truck to release sites away from the pumps. This facility uses behavioral barriers consisting of primary and secondary louvers to guide targeted fish into holding tanks for subsequent transport by truck to release sites within the Delta. When compatible with export operations, the louvers are operated with the objective of achieving water approach velocities for striped bass of approximately 1 foot per second from May 15 through October 31 and for salmon of approximately three feet per second from November 1 through May 14. Channel velocity criteria are a function of bypass ratios through the facility. Hauling trucks are used to transport salvaged fish to release sites. The SWP maintains two permanent release sites: one at Horseshoe bend on the Sacramento River and the other on Sherman Island at Curtis Landing on the San Joaquin River.

North Bay Aqueduct Intake at Barker Slough

The SWP uses the North Bay Aqueduct intake at Barker Slough to divert water from the north Delta near Cache Slough for agricultural and municipal uses in Napa and Solano counties. Maximum pumping capacity is about 175 cfs. Daily pumping rates typically range from 20 to 130 cfs. The intake has a positive barrier fish screen consisting of a series of flat, stainless steel, wedge-wire panels with a slot width of 3/32 inch. The facility is operated to maintain a screen approach velocity of no greater than 2 feet per second.

Delta Cross Channel

The Delta Cross Channel (DCC) is a controlled diversion channel located in the northern Delta between the Sacramento River and Snodgrass Slough, a tributary of the Mokelumne River. Reclamation operates the DCC to improve the transfer of water from the Sacramento River to the southern delta and export facilities at the Banks and Tracy pumping plants. To reduce scour in the channels on the downstream side of the DCC gate and to reduce potential flood flows that might occur from diverting water from the Sacramento River into the Mokelumne River system, the gates are closed whenever flows in the Sacramento River at Freeport reach 25,000 to 30,000 cfs on a sustained basis. Flows through the gates are determined by Sacramento River stage and are not affected by export rates in the south Delta. Pursuant to the WR Opinion and the SWRCB Water Quality Control Plan, the DCC gates are generally closed from February 1 through May 20 for the protection of emigrating juvenile salmon.

Description of the Operation Agreements, Constraints, and Objectives of the CVP and SWP

General operations of the CVP and SWP are discussed in this section and are provided for background information only. Specific operations of the CVP and SWP are described in the section entitled "Description of the Proposed Operations of the Central Valley Project Facilities During Water Year 1999 through March 2000."

Trinity River and Clear Creek Instream Flow Requirements

Water Right permits issued by the SWRCB for diversions from Trinity River and Clear Creek specify minimum downstream releases from Lewiston and Whiskeytown dams, respectively. Historically, approximately two thirds of the annual Trinity River inflow of 1.2 million AF was diverted to the Sacramento Basin. Based on a May 8, 1991, decision by the Secretary of the Interior, 340,000 AF is allocated annually for Trinity River instream flows. The amounts and timing of Trinity River exports to the Sacramento Basin are determined after consideration is given to forecasted water supply conditions and Trinity River in-basin needs, including carryover storage. Also, temperature control operations on the Sacramento River for winter-run chinook influence the timing of Trinity diversions and to some extent the total amount of diversion.

In October 1999, a draft Environmental Impact Statement/Report for the Trinity River Mainstem Fishery Restoration (DEIS/EIR) was released. This draft DEIS/EIR proposes a new instream flow schedule for the Trinity River combined with additional watershed protection efforts. The Trinity River Mainstem Fishery Restoration preferred alternative is the subject of a separate section 7 consultation between NMFS and Reclamation and FWS.

Two agreements govern releases from Whiskeytown Lake to Clear Creek: a 1960, Memorandum of Agreement (MOA) with DFG, and the October 6, 1999, Final Decision. The 1960 MOA with DFG established minimum flows to be released into Clear Creek from Whiskeytown Dam. Subsequently, in 1963 a release schedule from Whiskeytown Dam was developed and implemented, but was never finalized. The October 6, 1999, Final Decision allows for establishment of the target flow's described in the November 20, 1997, Interior Final Administrative Proposal on the Management of section 3406(b)(2) Water (AFRP Plan). The AFRP Plan identifies minimum flows for Clear Creek below Whiskeytown based upon thresholds of Trinity Reservoir storage. Target flows range from 100 to 200 cfs from October through May and from 100 to 150 cfs from June through September.

Spring Creek Debris Dam

In January 1980, Reclamation, DFG, and the SWRCB executed a Memorandum of Understanding (MOU) to implement actions to protect the Sacramento River system from heavy metal pollution from Spring Creek and adjacent watersheds. The MOU identifies agency actions and responsibilities. It established release criteria based on allowable concentrations of total copper and zinc in the Sacramento River below Keswick Dam. When Spring Creek Reservoir storage exceeds 5,000 AF, the MOU provides for "emergency" relaxation amounting to a 50% increase in the objective concentrations of copper and zinc. In recent years, Reclamation and DFG have agreed not to use the emergency criteria unless a spill occurs. The MOU also specifies a minimum schedule for monitoring copper and zinc concentrations at Spring Creek Debris Dam and in the Sacramento River below Keswick Dam. Reclamation has primary responsibility for the monitoring, although the DFG and Regional Water Quality Control Board (RWQCB) also collect and analyze samples on an as needed basis. The MOU states that the Reclamation agrees to operate according to these criteria and schedules provided that such operation will not cause flood control parameters on the Sacramento River to be exceeded or interfere unreasonably with other project requirements as determined by the Reclamation.

Upper Sacramento River Temperature Control

Elevated water temperatures in the upper Sacramento River have been recognized as a key factor in the decreasing populations of salmonid stocks that inhabit the river. Temperature on the Sacramento River system is influenced by several factors, including the relative temperatures and ratios of releases from Shasta Dam and from the Spring Creek Powerplant. The temperature of water released from these facilities is a function of the total storage at Shasta and Trinity lakes; depths from which releases are made; the percent of total releases from each depth; ambient air temperatures and other climatic conditions; tributary accretions and temperatures; and residence time in Keswick, Whiskeytown, and Lewiston reservoirs and in the Sacramento and Trinity rivers.

Reclamation operates the Shasta, Sacramento River, and Trinity River divisions of the CVP to meet, to the extent possible, the provisions of SWRCB Order 90-05 and the NMFS' (1993, as amended) WR Opinion. In 1990 and 1991, the SWRCB issued Water Rights Orders 90-05 and 91-01 modifying Reclamation's water rights for the Sacramento River. These SWRCB orders include temperature objectives for the Sacramento River including a daily average water temperature of 56^{0}F at Red Bluff Diversion Dam (RBDD) during periods when higher temperatures would be harmful to the fishery. Under the orders, the compliance point may be changed when the objective can not be met at RBDD. In addition, Order 90-05 modified the minimum flow requirements in the Sacramento River below Keswick Dam initially established in the Reclamation and DFG (1960) MOA.

Pursuant to SWRCB Order 90-05 and 91-01, Reclamation devised and currently implements the Sacramento-Trinity Water Quality Monitoring Network. This network is used to monitor temperatures and other parameters at key locations in the Sacramento and Trinity rivers. Also as a result of the SWRCB orders, the Upper Sacramento River Temperature Task Group was developed by Reclamation to formulate, monitor, and coordinate temperature control plans for the upper Sacramento and Trinity rivers. This group consists of representatives from Reclamation, SWRCB, NMFS, FWS, DFG, Western Area Power Administration, DWR, and the Hoopa Valley Indian Tribe. Each year, with a finite amount of cold water resources and competing demands for water, the Temperature Task Group is charged with devising temperature control plans that provide the best protection for salmon consistent with the CVP's temperature control capabilities, considering the needs of winter-run chinook, spring-run chinook, and fall-run chinook salmon.

Sacramento River Instream Flow Requirements

Minimum flow requirements established by the NMFS' WR Opinion are more conservative than most of the minimum flow requirements of WR 90-05. The reasonable and prudent alternative (RPA) contained in the WR Opinion requires a minimum flow of 3,250 cfs from October 1 through March 31 for all water year types. Also, as part of the RPA, ramping constraints for Keswick Dam release reductions from July 1 through March 31 were required as follows:

a. Releases must be reduced between sunset and sunrise.
b. When Keswick release is 6,000 cfs or greater, decreases may not exceed 15% per night. Decreases also, may not exceed 2.5% in one hour.
c. For Keswick release between 4,000 to 5,999 cfs, decrease may not exceed 200 cfs per night. Decreases may also not exceed 100 cfs per hour.
d. For Keswick releases between 3,999 and 3,250 cfs, decreases may not exceed 100 cfs per night.

Reclamation typically attempts to reduce releases from Shasta and Keswick dams to the minimum fishery release requirements by October 15 each year and to minimize changes in releases from Keswick Dam between October 15 to December 31. Releases may be increased during this period to meet unexpected downstream needs such as higher outflows at the Delta to meet water quality requirements or to meet flood control requirements. Releases from Keswick Dam may be reduced when downstream tributary inflows increase to a level that will meet downstream flow needs. To minimize release fluctuations, the base flow is selected with the intent of maintaining the desired target storage levels in Shasta Lake from October through December.

In addition to the NMFS' WR Opinion, the October 6, 1999, Final Decision allows for the establishment of minimum flows below Keswick Dam to assist meeting the objectives of the CVPIA AFRP. Minimum flow requirements below Keswick Dam for October through April are based on thresholds of Shasta Reservoir storage. Stability criteria dictate that November, December, February, March, and April flows be at least 90% of the preceding month's flow. The stability criteria also dictates that January's flow be at least 80% of December's Keswick flow. The stability criteria may be ignored if the preceding month's flow is above 6,000 cfs. From May through August, minimum flow remains at 3,250 cfs, although releases for temperature control will usually exceed this amount.

Sacramento River Recreation

Although not an authorized purpose, recreational use of Shasta Lake is significant with the prime recreation season extending from Memorial Day through Labor Day. The Reclamation attempts to have Shasta Lake full by Memorial Day and at an elevation of no less than 1,017 feet on Labor Day. This elevation corresponds to a drawdown of 50 feet below the top of the conservation pool and is just below the bottom of the flood control storage envelope. Storage typically peaks in May and significant drawdown usually does not begin until July and August. The drawdown rate varies but is typically the highest during July and August in response to irrigation demands and temperature control operations. Customary patterns of storage and release usually result in acceptable water levels during the prime recreational season. During drought periods, recreation opportunities at Shasta Lake are reduced because of hydrology and the drawdown required to meet CVP uses.

Sacramento River Flood Control

Flood control objectives for Shasta Lake require that releases are restricted to quantities that will not cause downstream flows or stages to exceed specified levels. These include a flow of 79,000 cfs at the tailwater of Keswick Dam and a stage of 39.2 feet in the Sacramento River at Bend Bridge gauging station, which corresponds to a flow of approximately 100,000 cfs. Flood control operations are based on regulating criteria developed by the US Army Corps of Engineers pursuant to the provisions of the Flood Control Act of 1944. Maximum flood space reservation is 1.3 million AF with variable storage space requirements based on an inflow parameter.

The flood control criteria for Shasta specify that releases should not be increased more than 15,000 cfs or decreased more than 4,000 cfs in any one hour period. In rare instances, the rate of decrease may have to be accelerated to avoid exceeding critical flood stages downstream.

Anderson-Cottonwood Irrigation District Diversion Dam

A contractual agreement between the Federal government and ACID provides for diversion of water and requires Reclamation to reduce Keswick Dam releases to accommodate the installation, removal, or adjustment of boards associated with the ACID diversion dam. Around April 1 of each year, ACID erects the diversion dam by raising the steel superstructure, installing the walkway, and then setting the boards in place. Placing the support beams generally requires flows in the Sacramento River to be reduced to less than 6,000 cfs. Wood and fiberglass stop logs are hand-placed across the pier to create a backwater pool for diversion into the ACID canal. Removing or adding boards in the dam generally requires flows of 10,000 cfs or less. The boards are taken out of the dam every year in mid-November. During the irrigation season, adjustment of the boards may be necessary due to changes in releases at Keswick Dam (FWS and ACID 1999).

Navigation Requirements and Related Issues at Wilkins Slough

As an authorized function of Shasta and Keswick dams, the Reclamation is obligated by the River and Harbors Act of 1937 and subsequent acts to operate Shasta Dam to improve navigation. Rivers and Harbors Committee Document Number 35, 73rd Congress recommended providing channel depths of 5 to 6 feet and 5,000 cfs minimum flow between Sacramento and Chico Landing. However, in 1952, a decision was made not to allocate storage space in Shasta Lake for navigation. In recent years, there has not been any commercial traffic between Sacramento and Chico Landing. Thus, the Corps has not maintained (dredged) this reach to preserve channel depths since 1972. While navigation for commercial vessels is no longer a concern on the lower Sacramento River, the 5,000 cfs minimum flow recommendation has served as the basis for the design of many irrigation pumping stations in the vicinity of Wilkins Slough, a reach of the Sacramento River immediately upstream of the confluence with the Feather River. To minimize the impact on these divertors, Shasta and Keswick dams are normally operated to provide a minimum flow of 5,000 cfs at Wilkins Slough in all but extremely dry years.

Red Bluff Diversion Dam

The Red Bluff Diversion Dam is currently operated according to the NMFS WR Opinion's RPA number 6 that specifies the Red Bluff gates will be raised from September 15 through May 14, with a provision for consideration of requests for closure of the gates for up to ten days, once per year, for critical diversion needs.

Feather River Instream Flow and Temperature Requirements

The August 1983 agreement between DWR and DFG "Concerning the Operation of the Oroville Division of the State Water Project for Management of Fish & Wildlife" sets criteria and objectives for flow and temperatures in the low flow channel and the reach of the Feather River between Thermalito Afterbay and Verona. This agreement establishes (1) minimum flows between Thermalito Afterbay Outlet and Verona which vary by water year type, (2) requires flow changes under 2,500 cfs to be reduce by no more than 200 cfs during any 24-hour period, except for flood control, failures, etc., (3) requires flow stability during the peak of the fall-run chinook spawning season, and (4) sets an objective of suitable temperature conditions during the fall months for salmon and during the late spring/summer for shad and striped bass.

Feather River Flood Control

Flood control requirements and regulating criteria for Oroville Reservoir are specified by the Corps flood control diagram (Corps 1971). From June 15 through September 15, no flood control restrictions exist. Full flood reservation space is required from November 17 through February 7. From September 16 through November 16 and from April 20 through May 31, reserved storage space for flood control is a function of the date. Beginning February 8 and continuing through April 20, flood reservation space is a function of both date and wetness.

American River Instream Flow Requirements

Prior to the CVPIA, the American River Division facilities were operated to help maintain natural fish production in the American River below Nimbus Dam by maintaining minimum fishery flows established in D-893 and proposed in D-1400 while also attempting to meet temperature objectives. The historical operation practice is termed a Modified D-1400 operation because it incorporates minimum flow objectives similar to D-1400 when hydrologic conditions are supportive and limits releases to D-893 minimum fish flow objectives only under very adverse hydrologic conditions. Therefore, minimum flows can range from 250 cfs in months with very low Folsom Reservoir storage to 3,000 cfs in months with high storage and hydrologic projections of ample runoff. D-893 allows for flows less than 250 cfs if water supply deficiencies are placed on CVP water users.

The October 6, 1999, Final Decision allows for the establishment of minimum flow recommendations below Nimbus Dam to assist meeting the fisheries objectives of the CVPIA. Minimum flow recommendations below Nimbus Dam from October through December are based on thresholds of Folsom Lake end-of-year September storage. Minimum flow recommendations from January through September are based on thresholds of Folsom Lake previous month storage plus inflow.

Regarding seasonal fluctuations and ramping of streamflows in the lower American River, Reclamation proposes to use draft criteria established by members of the American River Operations Group (see American River temperature control section below). This ramping criteria is presented in Table 1.

Table 1. Ramping criteria proposed for the Lower American River.

During any 24 hour period do not decrease Nimbus flows (measured in cfs) more than the ranges shown in column 1	Do not make individual Nimbus release decreases (measured in cfs) greater than values in column 2
Column 1	Column 2
20,000 to 16,000	1,000 - 1,500
16,000 to 13,000	1,000
13,000 to 11,000	500-800
11,000 to 9,500	500
9,500 to 8,000	500
8,000 to 7,000	300-350
7,000 to 6,000	300-350
6,000 to 5,500	250
5,500 to 5,000	250
Below 5,000 up to 500/24 hr.	50/hour

American River Temperature Control

Elevated water temperatures in the lower American River have been recognized as a key factor in the decreasing populations of salmonid stocks that inhabit the river. Temperatures on the American River are influenced by several factors, including the relative temperatures and volume of releases from the limited capacity of the coldwater pool reserve within Folsom Lake. The temperature of water released from Folsom Dam is a function of the following: total storage in Lake Folsom; depths from which releases are made; the percent of total releases from each depth; ambient air temperatures and other climatic conditions; tributary accretions and temperatures; and residence time in Folsom Lake and Lake Natoma.

The Reclamation operates the American River Division of the CVP to meet, to the extent possible, the temperature objectives for the Nimbus Fish Hatchery and the American River Trout Hatchery, while maintaining suitable temperatures for instream salmonids. The interagency American River Operations Group (Reclamation, FWS, NMFS, DFG, Sacramento County, and Save the American River Association) was created in 1996 and assists Reclamation adaptively manage releases and water temperature conditions on the lower American River to meet the needs of fall-run chinook salmon and steelhead within the river.

American River Flood Control

Flood control requirements and regulating criteria are specified by the Corps for the American River (Corps 1987). From June 1 through September 30, no flood control restrictions exist. Full flood reservation space is required from November 17 through February 7. From October 1 through November 16 and from April 21 through May 31, reserved storage space for flood control is a function of the date. Beginning February 8 and continuing through April 20, flood reservation space is a function of both date and wetness.

Since 1996, Reclamation has operated to modified flood control criteria which reserves 400 to 670 TAF of flood control space in Folsom Reservoir and a combination of upstream reservoirs. This flood control plan, which provides additional flood protection for the Lower American River, is implemented through an agreement between Reclamation and the Sacramento Area Flood Control Agency (SAFCA). The terms of the agreement allow some of the empty reservoir space in Hell Hole, Union Valley, and French Meadows to be treated as if it were available in Folsom. Although some of the SAFCA release criteria differ from the Corps plan, the criteria generally provide greater flood protection than existing Corps criteria for Folsom. Required flood control space may begin to decrease on March 1. Between March 1 and April 20, the rate of filling is a function of available upstream space. As of April 21, the required flood reservation is about 175 TAF. From April 21 to June 1, the required flood reservation is a function of the date only with Folsom storage allowed to completely fill on June 1.

Stanislaus River flow requirements

The operating criteria for New Melones Reservoir are governed by water rights, instream fish and wildlife requirements, Bay-Delta flow requirements, dissolved oxygen requirements, Vernalis water quality, and CVP contracts. Reclamation's obligation to meet downstream water rights was originally defined in a 1972 Agreement and Stipulation among the Reclamation, OID and SSJID. This agreement was superceded by a 1988 Agreement and Stipulation that requires Reclamation to release New Melones Reservoir inflows of up to 600,000 AF each year for diversion of water at Goodwin Dam by OID and SSJID in recognition of their water rights. In years when inflows to New Melones Reservoir are less than 600,000 AF per year, Reclamation provides all inflows plus one third the difference between the inflow for that year and 600,000 AF. This agreement also created a conservation account in which the difference between entitled quantity and the actual quantity diverted by OID and SSJID in a year may be stored in New Melones Reservoir for use in subsequent years. In addition, water is released from New Melones Reservoir to satisfy riparian water rights downstream of Goodwin Dam that total approximately 48,000 AF per year.

CVP operations on the Stanislaus River through water year 1999 are derived from a Two-Year Interim Stanislaus Agreement, known as the New Melones Interim Plan of Operations (NMIPO). The NMIPO defines categories of water supply based upon New Melones end-of-February storage plus forecasted March to September inflow. It then allocates water release for fishery, Bay-Delta criteria, water quality, and use by CVP contractors.

Until the Interior completes the development of long-term criteria, AFRP flow targets on the Stanislaus River are based on the water supply established by the NMIPO. After the water supply is calculated using the end-of-February storage plus forecasted March to September inflow, the total volume of water for fishery purposes is determined for the water year. Once the yearly volume is established, the distribution of flow volumes within the year are based on Reclamation and FWS coordination and consultation with DFG. This minimum annual volume allocated for fishery purposes (98,000 AF) is consistent with D-1422 requirements which require up to 98,000 AF of water per year be provided from New Melones Reservoir to the Stanislaus River on a distribution pattern to be specified each year by DFG for fish and wildlife purposes. However, under existing operations, the NMIPO may not always provide 98,000 AF for fish in all years.

Conductivity standards were originally established in D-1422 which specified that New Melones Reservoir be operated to maintain an average monthly level of conductivity, measured as total dissolved solids (TDS), of 500 parts per million (ppm) TDS for all months on the San Joaquin River at Vernalis. However, as part of WR 98-9, the operational water quality objectives at Vernalis were modified to include separate objectives for the irrigation and non-irrigation season according to the 1995 WQCP. The revised standards are average monthly concentrations of 0.7 mS/cm conductivity (approximately 455 ppm TDS) from April through August and 1 mS/cm (approximately 650 ppm TDS) from September through March.

Water service contracts held by Reclamation for the delivery of water from New Melones were based on a 1980 hydrologic evaluation of the long-term availability of water in the Stanislaus River basin. Based on this evaluation, Reclamation entered into a long-term service contract for up to 49,000 AF per year of water annually (based on a firm water supply) and two long-term service contracts totaling 106,00 AF per year (based on an interim water supply).

In addition to the above criteria, Reclamation and DWR signed (1998) a statement of support and committed to pursue the implementation of the San Joaquin River Agreement (SJRA) through the SWRCB, along with other agencies comprising the San Joaquin Tributary Association. The SJRA includes a 12-year experimental program providing flows and exports in the lower San Joaquin River during a 31-day pulse flow period in April-May. It also provides for the collection of experimental data during the pulse flow period to further understand the effects of flows, exports, and the Head of Old River Barrier on salmon survival. This experimental program is commonly referred to as the Vernalis Adaptive Management Program (VAMP). Within the SJRA, the NMPIO is assumed to form part of the basis for which flows will be provided on the San Joaquin River to meet the 31-day pulse flow targets during April-May. Additional flows to meet the targets will be provide by other sources in the San Joaquin River under the control of other signatories of the SJRA.

Stanislaus River Hydropower Operations

Power generation occurs when New Melones storage is above the minimum power pool of 300,000 AF. Reservoir levels are maintained whenever possible to provide maximum energy generation.

Stanislaus River Flood Control

New Melones Reservoir flood control operation is coordinated with the operation of Tulloch Reservoir. The flood control objective is to maintain flood flows at the Orange Blossom Bridge at less than 8,000 cfs. However, Reclamation attempts to operate New Melones Dam, whenever possible, to provide flows less than 1,500 cfs in order to prevent seepage and flooding problems associated with flows above this level. Up to 450,000 AF of the 2.4 MAF storage volume in New Melones Reservoir and 10,000 AF of Tulloch Reservoir storage is dedicated for flood control. According to Army Corps of Engineer requirements, part or all of the dedicated flood control storage may be used for conservation storage depending on the time of year and the current flood hazard.

CVP and SWP Delta Facilities

Delta operations of CVP and SWP facilities are largely determined by SWRCB decisions and orders. Reclamation and DWR currently operate CVP and SWP facilities in coordination with the water export facilities in the south Delta to comply with the terms and conditions of SWRCD Decision 990, Decision 1291, Decision 1485, and Order WR 95-6. Order WR 95-6 had the effect of temporarily making the CVP and SWP's water rights consistent with their voluntary compliance with the objectives in the 1995 Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary. On December 3, 1998, the SWRCB adopted Order WR 98-09 which temporarily extended Order WR 95-6, as modified, until adoption of a comprehensive water rights decision that allocates final responsibility for meeting 1995 Bay-Delta objectives or December 31, 1999, whichever comes first. On December 29, 1999, the SWRCB adopted Decision 1641 (D-1641). D-1641 implements flow objectives for the Bay-Delta Estuary, approves a petition to change points of diversion of the CVP and SWP in the southern Delta, and approves a petition to change places of use and purposes of use of the CVP.

Central Valley Project Improvement Act

Operations of the CVP reflect actions taken in accordance with provisions of the CVPIA, particularly sections 3406(b)(1), (b)(2), and (b)(3). The October 6, 1999, Final Decision combined with the May 1997 AFRP Plan provide the basis for implementing upstream and Delta fish actions with CVP yield. The FWS has identified actions that contribute to the CVPIA goal of doubling the natural production of anadromous fish and FWS anticipates selecting actions from this list for the annual management of the 800,000 AF of yield dedicated under (b)(2). Not all the actions on this list will be implemented in any given year, but instead FWS will annually select the appropriate actions for use of (b)(2) water supplies based on biological needs, hydrologic circumstances, and water availability. To assist Reclamation and FWS in the accounting methodology, and the development and implementation of annual actions with (b)(2) water supplies, the Department of Interior has established a B2 Interagency Team (B2IT) consisting of representatives from DWR, DFG, Reclamation, FWS, and NMFS.

Description of the Proposed Operations of the Central Valley Project Upstream Facilities from December 1999, through March 2000

Information regarding the proposed operation of CVP upstream facilities during the period between December 1, 1999 and March 31, 2000, was obtained from the following: 1) the January 1999, biological assessment; 2) water year 2000 (90% exceedance) forecast dated December 21, 1998; and 3) water year 2000 (50% and 90% exceedance) forecasts from a November 4, 1999, workshop. For the period of December 1, 1999 through March 31, 2000, the proposed operation of CVP upstream facilities assessed in this biological opinion are as follows:

Trinity River Division

Trinity And Lewiston Dams

Based on the May 8, 1991, decision by the Secretary of the Interior, 340,000 AF is annually allocated for Trinity River flows. Exports of Trinity water to the Sacramento Basin are determined after consideration is given to forecasted Trinity Basin water supply and Trinity in-basin needs, including carryover storage. Trinity Basin exports to the Sacramento River provide increased water supply, power generation, and temperature control in the upper Sacramento River for the CVP. In Water Year 1999 through March 2000, the Reclamation proposes to coordinate the timing of Trinity Basin exports with releases at Shasta Dam to best meet temperature objectives on the upper Sacramento that were established in the 1993 NMFS WR Opinion.

Whiskeytown Dam and Reservoir on Clear Creek

From December 1, 1999 through March 31, 2000, the Reclamation proposes to operate Whiskeytown Dam to regulate inflows for power generation and recreation; to support upper Sacramento temperature objectives; and to provide releases to Clear Creek consistent with AFRP objectives. From December 1, 1999, through March 31, 2000, Reclamation proposes to operate Whiskeytown Reservoir under the 50% exceedence forecast to maintain an average monthly flow of 200 cfs in Clear Creek. Under the 90% exceedence forecast, Reclamation proposes to operate Whiskeytown Reservoir to maintain an average monthly flow of 200 cfs in Clear Creek during December 1999, and 150 cfs in Clear Creek from January 1 through March 31, 2000.

<u>Shasta Division</u>

Shasta Reservoir Storage

From December 1999 through March 2000, the Reclamation proposes to operate the Shasta Reservoir level to meet the needs of the CVP (i.e., water delivery to irrigation districts, flood control, D-1485 water quality standards, fish and wildlife protection, etc.) and to meet the provisions of SWRCB Order 90-05 and the 1993 WR Opinion. From December 1, 1999 through March 31, 2000, the Reclamation proposes to release flows to the Sacramento River at Keswick Dam and Red Bluff Diversion Dam that are consistent with AFRP flow objectives. Reclamation will operate to the ramping criteria established in the WR Opinion for Keswick release reductions from July 1 through March 31:

a. Releases must be reduced between sunset and sunrise.
b. When Keswick release is 6,000 cfs or greater, decreases may not exceed 15% per night. Decreases may also not exceed 2.5% in one hour.
c. For Keswick release between 4,000 to 5,999 cfs, decreases may not exceed 200 cfs per night. Decreases may also not exceed 100 cfs per hour.
d. For Keswick releases between 3,999 and 3,250 cfs, decreases may not exceed 100cfs per night.

Flood control operations and other emergencies are not affected by these release change criteria.

Wilkins Slough

Wilkins Slough is located on the mainstem Sacramento River immediately upstream of the confluence with the Feather River. While commercial navigation is no longer a concern on the lower Sacramento River, the 5,000 cfs minimum flow established at Chico Landing for navigation served as the basis for the design of many irrigation pumping stations on this reach of the river. Diverters are able to operate for extended periods at flows as low as 4,000 cfs at Wilkins Slough, but pumping operations become severely affected at flows lower than this. From December 1999, through March 2000, the Reclamation's proposed flows for the 50% and 90%

exceedence forecasts meet, or exceed, the 5,000 cfs minimum flow at Wilkins Slough during all months.

Spring Creek Debris Dam

Reclamation proposes to operate Spring Creek Debris Dam and Reservoir in coordination with Shasta Dam and the Trinity River Division to meet the release criteria established in the 1980 MOU. The release criteria is based on allowable concentrations of total copper and zinc in the Sacramento River below Keswick Dam.

Sacramento River Division

Red Bluff Diversion Dam

From December 1, 1999, through March 31, 2000, the Reclamation proposes to operate the RBDD with the gates raised according to the WR Opinion's RPA to keep the gates raised from September 15 through May 14 with a provision that intermittent gate closures up to ten days may be approved on a case-by case basis for critical diversion needs.

American River Division

Folsom Dam and Reservoir and Nimbus Dam and Reservoir

From December 1, 1999, through March 31, 2000, the Reclamation proposes to provide monthly average release flows from Folsom Reservoir and Nimbus Dam that are generally consistent with AFRP flow objectives. AFRP flow objectives in the American River are intended to decrease water temperatures and increase spawning, incubation, rearing, and emigration habitat for fall-run chinook salmon and steelhead while providing benefits for estuarine species as well.

For the protection of Central Valley steelhead, Reclamation proposes to adaptively manage releases and water temperatures in the Lower American River with the participation of NMFS through the American River Operations Group. This Operations Group meets monthly to review past operations, evaluate future operations, and develop operational alternatives that optimize conditions for steelhead and fall-run chinook salmon.

Eastside Division

New Melones Dam And Reservoir

From December 1, 1999, through March 31, 2000, Reclamation proposes to operate New Melones Dam and Reservoir according to the New Melones Interim Plan of Operation (NMIPO). The proposed flows for this period in the Stanislaus River below Goodwin Dam are predicted under the 50% exceedence forecast to meet the AFRP flow targets.

From January 2000 through March 31, 2000, Reclamation proposes to monitor emigrating salmon and steelhead smolts in the Stanislaus River to evaluate the effects of Reclamation's New Melones Reservoir operations on these species. A screw trap will be operated approximately 18 miles downstream of Goodwin Dam at Oakdale to: 1) collect information on the number, timing, and lengths of outmigrant salmonids; 2) estimate the number of steelhead and chinook that outmigrate; 3) evaluate how physical and environmental factors influence migration timing, migration rate, and survival of steelhead and chinook; and 4) evaluate how reservoir operations at New Melones and Goodwin dams influence migration timing, migration rate, and survival of juvenile steelhead and chinook. Reclamation provided a detailed description of the monitoring program to NMFS by letter dated May 14, 1999.

Description of the Proposed Operations of the State Water Project Upstream Facilities December 1999 through March 2000

Information regarding the proposed operation of SWP upstream facilities during the period between December 1, 1999, through March 31, 2000, was obtained from the following: 1) the January 1999, biological assessment; 2) water year 2000 (90% exceedance) forecast dated December 21, 1998; and 3) water year 2000 (50% and 90% exceedance) forecasts presented at a November 4, 1999, workshop. For the period of December 1, 1999 through March 31, 2000, the proposed operation of SWP upstream facilities assessed in this biological opinion are as follows:

Oroville Thermalito Complex

From December 1999, through March 2000, the DWR proposes to provide monthly average flows of 600 cfs for the reach of the Feather River between the Feather River Hatchery Dam and the Thermalito Afterbay (i.e., the low flow channel). Below the Thermalito Afterbay outlet, DWR proposes to provide a minimum flow of 1,700 cfs or greater based upon criteria established in a 1983 agreement between DWR and CDFG, "Concerning the Operation of the Oroville Division of the State Water Project for Management of Fish & Wildlife". In addition, when flows below Thermalito Afterbay are less than 2500 cfs, releases will not be reduced more than 200 cfs during any 24-hour period, except for flood control releases, failures, etc., pursuant to the 1983 agreement with DFG.

For temperature control in the Feather River, DWR proposes to meet the criteria established in the 1983 DFG agreement which specifies specific temperature requirements for the Feather River Fish Hatchery by season and a general criteria to provide suitable temperatures during the fall months (after September 15) for fall-run chinook salmon. Through the manipulation of a multi-level outlet device on Oroville Dam, management of releases to meet temperature criteria for the Feather River Hatchery will dictate the resulting Feather River temperatures downstream in the low flow channel and below Thermalito Afterbay. However, water temperatures below the Thermalito Afterbay outlet are also greatly influenced by the temperature of releases from the Afterbay.

Description of the Proposed Operations of Central Valley Project and State Water Project Delta Facilities December 1999 through March 2000

Information regarding the proposed operation of CVP and SWP Delta facilities during the period between December 1, 1999, through March 31, 2000, was obtained from the following: 1) the January 1999, biological assessment; 2) water year 2000 (90% exceedance) forecast dated December 21, 1998; and 3) water year 2000 (50% and 90% exceedance) forecasts from a November 4, 1999, workshop. For the period of December 1, 1999 through March 31, 2000, the proposed operations of CVP and SWP Delta facilities assessed in this biological opinion are as follows:

<u>CVP Export Facilities and Associated Tracy Fish Collection Facility</u>

Reclamation proposes to operate the Tracy Pumping Plant and Tracy Fish Collection Facility in compliance with SWRCB D-1641, the NMFS February 12, 1993, WR Opinion (as amended), the FWS March 6, 1995, biological opinion for delta smelt, the November 6, 1998 CALFED Operations Group Sacramento River Spring-run Chinook Salmon Protection Plan (Spring-run Protection Plan), and the October 6, 1999, Final Decision. The Tracy Pumping Plant will typically operate at or near its maximum rate of 4,600 cfs except during periods of low Delta inflow, curtailments for the Spring-run Protection Plan, implementation of CVPIA (b)(2) fisheries actions, or curtailments for water quality exceedances.

The Tracy Fish Collection Facility will be operated to intercept fish before they pass through the canal to the Tracy Pumping Plant. Fish passing through the facility will be sampled at intervals no less than 10 minutes every 2 hours. Fish observed during sampling intervals will be identified to species, measured to fork length, examined for marks or tags, and placed in the collection facilities for transport by tanker truck to release sites away from the pumps. All other fish passing through the facility will be collected and transported by tanker truck to Delta release sites away from the pumps. To the extent possible, the louvers of the fish collection facility will be operated to meet water approach velocities established for salmon of approximately three feet per second from November 1 through May 14.

Reclamation recognizes that Delta export operations must be coordinated with other actions and programs in the Delta and Central Valley. Through the CALFED Operations Group, NMFS and the other CALFED agencies will be updated monthly on Reclamation's Delta operations and participate in decisions which involve change in export rates, barrier operations, or reservoir releases. The CALFED Operations Group will also serve to distribute information regarding CVPIA (b)(2) water actions.

<u>SWP Export Facilities, Clifton Court Forebay, and Associated Skinner Fish Protection Facility</u>

DWR proposes to operate the Banks Pumping Plant and Skinner Fish Protection Facility in compliance with SWRCB D-1641, the NMFS February 12, 1993, WR Opinion (as amended), the FWS March 6, 1995, biological opinion for delta smelt, and the Spring-run Protection Plan. The

January 1999 project description also indicates the 1999/2000 DWR operations plan includes a proposal to facilitate implementing the Delta and upstream reservoir CVPIA (b)(2) actions as described in the November 20, 1997, Final Administrative Proposal on the Management of Section 3406(b)(2) Water, in a manner that reduces potential water supply impacts on Delta actions. Although, this Administrative Proposal has been subsequently superceded by the October 6, 1999, Final Decision, the fisheries protection actions are basically the same and a process to facilitate implementation and ensure (b)(2) actions do not adversely affect the SWP remain in place. DWR recognizes the (b)(2) actions in the Delta can not be successfully implemented without the coordination and cooperation of the SWP and, thus, DWR remains fully engaged in the process to coordinate operations and develop tools to avoid or minimize water supply impacts.

The Banks Pumping Plant will operate up to its maximum permitted rate of 6,680 cfs except during periods of low Delta inflow, curtailments for the Spring-run Chinook Protection Plan, implementation of CVPIA (b)(2) fisheries actions, curtailments for water quality exceedances, or reduced demand. During the period between December 15 and March 15, the Banks Pumping Plan may operate above 6,680 cfs to export one-third of the total flow of the San Joaquin River as measured at Vernalis when its total flow exceeds 1,000 cfs. Under the 50% exceedance forecast, DWR forecasts the SWP share of San Luis Reservoir will be filled in mid- to late January 2000. Under the 90% exceedance forecast, the SWP share of San Luis Reservoir is filled in March or April 2000. Upon filling the SWP portion of San Luis Reservoir, DWR predicts pumping at Banks will be reduced to a lower level to support exports for CVP Cross Valley supplies and delivery of an "undetermined" amount of interruptible supplies to SWP contractors.

The Skinner Fish Protection Facility will be operated to intercept fish before they pass down the California Aqueduct to the Banks Pumping Plant. Fish passing through the facility will be sampled at intervals no less than 10 minutes every 2 hours. Fish observed during sampling intervals will be identified to species, measured to fork length, examined for marks or tags, and placed in the collection facilities for transport by tanker truck to release sites away from the pumps. All other fish passing through the facility will be collected and transported by tanker truck to Delta release sites away from the pumps. To the extent possible, the louvers of the fish collection facility will be operated to meet water approach velocities established for salmon of approximately three feet per second from November 1 through May 14.

DWR also recognizes that Delta export operations must be coordinated with other actions and programs in the Delta and Central Valley. Through the CALFED Operations Group, NMFS and the other CALFED agencies will be updated monthly on DWR's Delta operations and participate in decisions which involve any change in export rates, barrier operations, or reservoir releases.

CVP and SWP Delta Exports and San Luis Reservoir Storage

Based on the October 1999, forecast (dated November 3, 1999), a summary of Delta water export operations and San Luis Reservoir storage from December 1999, through March 2000, under a 90% exceedence forecast and 50% exceedence forecast are presented in Tables 2 and 3, respectively. Under the 90% exceedence forecast, Reclamation and DWR propose to export approximately 1,804,000 AF of water and total San Luis Reservoir storage will reach approximately 1,763,000 AF at the end of March 2000. Under the 50% exceedence forecast, Reclamation and DWR propose to export 1,960,000 AF and total San Luis Reservoir storage will reach approximately 1,796,000 AF at the end of March 2000.

Table 2. Delta Operations Summary and San Luis Storage (TAF) under 90% Exceedence Forecast

	December	January	February	March
Tracy Export	152	258	215	175
USBR Banks Export	0	50	0	0
Contra Costa Export	3	3	5	6
State Export	203	325	178	231
Total Export	358	636	398	412
Excess Outflow	3,211	1,733	1,837	427
% Export/Inflow	42%	65%	45%	35%
San Luis Federal Storage	379	568	664	698
San Luis State Storage	599	869	969	1,065
San Luis Total Storage	978	1,438	1,633	1,763

Table 3. Delta Operations Summary and San Luis Reservoir Storage (TAF) under a 50% Exceedence Forecast.

	December	January	February	March
Tracy Export	158	158	233	255
USBR Banks Export	0	50	0	30
Contra Costa Export	7	6	5	8
State Export	411	195	191	253
Total Export	576	409	429	546
Excess Outflow	5,203	11,201	24,386	24,359
% Export/Inflow	45%	26%	17%	19%
San Luis Federal Storage	385	474	588	732

San Luis State Storage	1,030	1,065	1,065	1,065
San Luis Total Storage	1,415	1,539	1,653	1,796

Under the 90% exceedence forecast, the export/inflow (E/I) ratios remain near or at the maximum rate permitted by the SWRCB under D-1641 and DWR fills the SWP share of San Luis storage (approximately 1.07 MAF) in March. Reclamation is not able to fill the CVP share of San Luis storage under the 90% exceedence forecast. Under the 50% exceedence forecast, the E/I ratio remains significantly below the maximum rate permitted by D-1641 in all months and DWR fills the SWP share of San Luis storage in January. Upon filling the SWP share of San Luis storage, SWP exports are reduced considerably during January, February, and March. Reclamation is not able to fill the CVP share of San Luis storage under the 50% exceedence forecast.

CVPIA Proposed Delta Actions

For December 1999, and January 2000, Delta actions were developed by members of the B2IT to provide protection for Central Valley spring-run chinook salmon and to provide a concurrent evaluation of salmon smolt survival (the B2IT was established by the October 6, 1999, Final Decision and includes biologists with NMFS, DFG, FWS, Reclamation, and DWR). For spring-run chinook protection, the B2IT proposed a 14-day export reduction be implemented at the CVP's Tracy Pumping Plant when monitoring results in the lower Sacramento River and Delta indicate that marked and wild juvenile salmon are migrating through the Delta. In conjunction with the export reduction, a salmon survival evaluation would also occur. The target export rate for the December reduced export period and evaluation ranges from 7,000 to 7,400 cfs. A second 14-day evaluation during January was proposed with a target export rate of 3,000 cfs. In total, FWS estimates that 200,000 to 300,000 AF of (b)(2) water supplies are available to reduce CVP pumping during December and January, and these supplies are anticipated to allow for export reductions to this extent under a 50% exceedance forecast.

As discussed in Attachment 2 of the October 6, 1999, Final Decision, flexibility has been incorporated into both the December and January (b)(2) actions to maximize the benefits to wild juvenile salmon outmigrants, accommodate CVP and SWP operational constraints, adhere to the (b)(2) accounting process and budget, and address hydrological and biological uncertainties. In coordination with the B2IT, FWS and Reclamation may modify actual export rates, duration, and schedule of these pumping curtailments.

CALFED Operations Group Spring-run Chinook Protection Plan

From December 1999, through March 2000, Reclamation and DWR propose to operate the CVP and SWP Delta pumping plants and the Delta Cross Channel (DCC) gates in compliance with the CALFED Operations Group Sacramento River Spring-run Chinook Salmon Protection Plan (November 6, 1998). The Spring-Run Protection Plan was developed by DWR and Reclamation with the assistance of the CALFED Operations Group to comply with the California Fish and

Game Commission's Special Order related to spring-run chinook incidental take authorization under the California Endangered Species Act. This plan includes monitoring of juvenile salmon movements in the lower Sacramento River and Delta, data assessment procedures, specific indicators of spring-run chinook vulnerability to impacts from Delta pumping, and operation responses to minimize the effects of Delta export pumping. Three responses to specific indicators are presented in the plan: (1) response number 1 requires the Data Assessment Team (DAT) to more frequently analyze and report the results of fisheries monitoring programs; (2) response number 2 requires the closure of the Delta Cross Channel gates, if not already closed; and (3) response number 3 requires the development and possible implementation of CVP/SWP operational adjustments within 24 hours. In addition, the plan indicates that if the DCC gates are not already closed on December 1 due to indicators, then Reclamation shall close the gates until the DAT recommends opening the DCC.

Delta Cross Channel

During the period of December 1, 1999, through January 31, 2000, DCC gates will be closed by Reclamation for the protection of fish provided that water quality is not a concern in the central or south Delta. From February 1 through May 20, the SWRCB D-1641 requires the DCC gates remain closed for the protection of emigrating juvenile salmon in the Sacramento River.

North Bay Aqueduct Intake at Barker Slough

DWR proposes to operate the North Bay Aqueduct intake in the range from 20 to 130 cfs. Project deliveries during 1999 are expected to be no more than 51,500 AF

Suisun Marsh Salinity Control Gates

DWR may operate the Suisun Marsh Salinity Control Gates (SMSCG) during the period covered under this opinion from December 1, 1999, through March 31, 2000, but will only operate the SMSGC as needed to meet SWRCB and Suisun Marsh Preservation Agreement water quality standards. The non-operation configuration of the SMSCG during this period typically consists of the flashboards installed, but the radial gate operation is stopped and held open. Flashboards will be removed if it is determined that salinity conditions at all trigger stations would remain below standards for the remainder of the control season through May 31.

Rock Slough

Reclamation proposes that CCWD will operate the Contra Costa Canal and Rock Slough intake to divert 7 TAF, 6 TAF, 5 TAF, and 8 TAF during December, January, February, and March, respectively under the 50% exceedence forecast. Under the 90% exceedence forecast, Reclamation and CCWD propose to divert 3 TAF, 3 TAF, 5 TAF, and 6 TAF during December, January, February, and March, respectively. In general, CCWD's total diversions from the Delta will be reduced in drier periods when water quality and flows are low.

SWP Delta Pumping Plant Fish Protection Agreement (4-Pumps Agreement)

Pursuant to the December 30, 1986, SWP Delta Pumping Plant Fish Protection Agreement (4-Pumps Agreement), DWR and DFG have approved four projects that include quantified benefits to Central Valley spring-run chinook salmon. Three of the four projects have been implemented and are totally or partially funded by the 4-Pumps Mitigation Agreement. These three are: (1) DFG warden overtime for 3 years (1997-1999) at a cost of $112,500; (2) Durham Mutual/Parrot Phelan Screen and Ladders completed in 1995, $301,504 provided for over-budget project costs; and (3) Mill Creek Water Exchange project completed in 1992 has been funded annually at approximately $35,000 per year. The fourth project that was approved for funding is the Deer Creek Water Exchange project. The Deer Creek Project is scheduled for completion in 2001 and is estimated to cost approximately $40,000 per year.

DFG and DWR have also approved two other 4-Pumps salmon projects to off-set losses at the SWP Delta pumps. The eradication of northern pike from Lake Davis and 10 additional game wardens to reduce poaching in the Delta were funded through the 4-Pumps Agreement.

Action Area

For the purposes of this Opinion, the action area includes the following: Shasta Dam and the reaches of the Sacramento River downstream of this dam that may be affected by the operation of Reclamation facilities; Whiskeytown Dam and the reaches of Clear Creek downstream of this dam that may be affected by the operation of Reclamation facilities; Oroville Dam and the reaches of the Feather River downstream of this dam that may be affected by the operation of DWR facilities; Folsom Dam and the reaches of the American River downstream of this dam that may be affected by the operation of Reclamation facilities; New Melones Dam and the reaches of the Stanislaus River downstream of this dam that may be affected by the operation of Reclamation facilities; and the Sacramento-San Joaquin Delta. An action area is defined as: "all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action" (50 CFR § 402.02).

III. LISTED SPECIES AND CRITICAL HABITAT

This biological opinion analyzes the effects of CVP and SWP operations from December 1999, through March 31, 2000 on the threatened Central Valley spring-run chinook salmon (*Oncorhynchus tshawytscha*), threatened Central Valley steelhead *(O. mykiss)*, designated critical habitat for Central Valley spring-run chinook salmon, and designated critical habitat for Central Valley steelhead within the action area.

Central Valley Spring-run Chinook Salmon - Threatened: Population Trends, Life History, and Biological Requirements

Effective November 16, 1999, NMFS listed Central Valley spring-run chinook salmon as threatened under the Endangered Species Act (64 FR 50394). Historically, spring-run chinook salmon were predominant throughout the Central Valley, occupying the upper and middle reaches of the San Joaquin, American, Yuba, Feather, Sacramento, McCloud, and Pit Rivers, with smaller populations in most other tributaries with sufficient habitat for over-summering adults (Stone 1874, Rutter 1904, Clark 1929). The Central Valley drainage as a whole is estimated to have supported spring-run chinook salmon runs as large as 600,000 fish between the late 1880s and 1940s (DFG 1998). Before the construction of Friant Dam, nearly 50,000 adults were counted in the San Joaquin River (Fry 1961). Following the completion of Friant Dam, the native population from the San Joaquin River and its tributaries was extirpated. Also, spring-run no longer exist in the American River due to Folsom Dam.

Clark (1929) estimated that originally there were 6,000 miles of salmon habitat in the Central Valley system and that 80% of this habitat had been lost by 1928. Yoshiyama et al. (1996) calculated that roughly 2,000 miles of salmon habitat was actually available before dam construction and mining, and concluded that 82% is not accessible today. Clark (1929) did not give details about his calculation. Whether Clark's or Yoshiyama's calculation is used, only remnants of their former range remain accessible today in the Central Valley (DFG 1998).

Impassable dams block access to most of the historical headwater spawning and rearing habitat of Central Valley spring-run chinook salmon. In addition, much of the remaining, accessible spawning and rearing habitat is severely degraded by elevated water temperatures, agricultural and municipal water diversions, unscreened and poorly screen water intakes, restricted and regulated streamflows, levee and bank stabilization, and poor quality and quantity of riparian and shaded riverine aquatic (SRA) cover.

Natural spawning populations of Central Valley spring-run chinook salmon are currently restricted to accessible reaches in the upper Sacramento River, Antelope Creek, Battle Creek, Beegum Creek, Big Chico Creek, Butte Creek, Clear Creek, Deer Creek, Feather River, Mill Creek, and Yuba River (DFG 1998; FWS, unpublished data). With the exception of Butte Creek and the Feather River, these populations are relatively small ranging from a few fish to several hundred. Butte Creek returns in 1998 and 1999 numbered approximately 20,000 and 3,600, respectively (DFG unpublished data). On the Feather River, significant numbers of spring-run chinook, as identified by run timing, return to the Feather River Hatchery. However, coded-wire-tag information from these hatchery returns indicates substantial introgression has occurred between fall-run and spring-run chinook populations in the Feather River due to hatchery practices. Over time, the spring-run within the Feather River may become homogeneous with Feather River fall-run fish unless current hatchery practices are changed.

Spring-run chinook salmon adults are estimated to leave the ocean and enter the Sacramento River from March to July (Myers et al. 1998). This run timing is well adapted for gaining access to the upper reaches of river systems, 1,500 to 5,200 feet in elevation, prior to the onset of high water temperatures and low flows that would inhibit access to these areas during the fall. Throughout this upstream migration phase, adults require streamflows sufficient to provide olfactory and other orientation cues used to locate their natal streams. Adequate streamflows are also necessary to allow adult passage to upstream holding habitat in natal tributary streams. The preferred temperature range for spring-run chinook salmon completing their upstream migration is 38° F to 56° F (Bell 1991; DFG 1998).

When they enter freshwater, spring-run chinook salmon are immature and they must stage for several months before spawning. Their gonads mature during their summer holding period in freshwater. Over-summering adults require cold-water refuges such as deep pools to conserve energy for gamete production, redd construction, spawning, and redd guarding. The upper limit of the optimal temperature range for adults holding while eggs are maturing is 59° F to 60° F (Hinz 1959). Unusual stream temperatures during spawning migration and adult holding periods can alter or delay migration timing, accelerate or retard mutations, and increase fish susceptibility to diseases. Sustained water temperatures above 80.6° F are lethal to adults (Cramer and Hammack 1952; DFG 1998).

Adults prefer to hold in deep pools with moderate water velocities and bedrock substrate and avoid cobble, gravel, sand, and especially silt substrate in pools (Sato and Moyle 1989). Optimal water velocities for adult chinook salmon holding pools range between 0.5-1.3 feet-per-second and depths are at least three to ten feet (G. Sato unpublished data, Marcotte 1984). The pools typically have a large bubble curtain at the head, underwater rocky ledges, and shade cover throughout the day (Ekman 1987).

Spawning typically occurs between late-August and early October with a peak in September. Once spawning is completed, adult spring-run chinook salmon die. Spawning typically occurs in gravel beds that are located at the tails of holding pools (USFWS 1995a). Spring-run adults have been observed spawning in water depths of 0.8 feet or more, and water velocities from 1.2-3.5 feet-per-second (Puckett and Hinton 1974). Eggs are deposited within the gravel where incubation, hatching, and subsequent emergence takes place. Optimum substrate for embryos is a mixture of gravel and cobble with a mean diameter of one to four inches with less than 5% fines, which are less than or equal to 0.3 inches in diameter (Platts et al. 1979, Reiser and Bjornn 1979). The upper preferred water temperature for spawning adult chinook salmon is 55° F (Chambers 1956) to 57° F (Reiser and Bjornn 1979).

Length of time required for eggs to develop and hatch is dependant on water temperature and is quite variable, however, hatching generally occurs within 40 to 60 days of fertilization (Vogel and Marine 1991). In Deer and Mill creeks, embryos hatch following a 3-5 month incubation period (USFWS 1995). The optimum temperature range for chinook salmon egg incubation is 44° F to 54° F (Rich 1997). Incubating eggs show reduced egg viability and increased mortality at temperatures greater than 58° F and show 100% mortality for temperatures greater than 63° F (Velson 1987). Velson (1987) and Beacham and Murray (1990) found that developing chinook salmon embryos exposed to water temperatures of 35° F or less before the eyed stage experienced 100% mortality (DFG 1998).

After hatching, pre-emergent fry remain in the gravel living on yolk-sac reserves for another two to four weeks until emergence. Timing of emergence within different drainages is strongly influenced by water temperature. Emergence of spring-run chinook typically occurs from

November through January in Butte and Big Chico Creeks and from January through March in Mill and Deer Creeks (DFG 1998).

Post-emergent fry seek out shallow, nearshore areas with slow current and good cover, and begin feeding on small terrestrial and aquatic insects and aquatic crustaceans. As they grow to 50 to 75 mm in length, the juvenile salmon move out into deeper, swifter water, but continue to use available cover to minimize the risk of predation and reduce energy expenditure. The optimum temperature range for rearing chinook salmon fry is 50° F to 55° F (Boles et al. 1988, Rich 1997, Seymour 1956) and for fingerlings is 55° F to 60° F (Rich 1997).

In Deer and Mill creeks, juvenile spring-run chinook, during most years, spend 9-10 months in the streams, although some may spend as long as 18 months in freshwater. Most of these "yearling" spring-run chinook move downstream in the first high flows of the winter from November through January (USFWS 1995, DFG 1998). In Butte and Big Chico creeks, spring-run chinook juveniles typically exit their natal tributaries soon after emergence during December and January, while some remain throughout the summer and exit the following fall as yearlings. In the Sacramento River and other tributaries, juveniles may begin migrating downstream almost immediately following emergence from the gravel with emigration occurring from December through March (Moyle, et al. 1989, Vogel and Marine 1991). Fry and parr may spend time rearing within riverine and/or estuarine habitats including natal tributaries, the Sacramento River, non-natal tributaries to the Sacramento River, and the Delta. In general, emigrating juveniles that are younger (smaller) reside longer in estuaries such as the Delta (Kjelson et al. 1982, Levy and Northcote 1982, Healey 1991). The brackish water areas in estuaries moderate the physiological stress that occurs during parr-smolt transitions. Although fry and fingerlings can enter the Delta as early as January and as late as June, their length of residency within the Delta is unknown but probably lessens as the season progresses into the late spring months (DFG 1998).

In preparation for their entry into a saline environment, juvenile salmon undergo physiological transformations known as smoltification that adapt them for their transition to salt water (Hoar 1976). These transformations include different swimming behavior and proficiency, lower swimming stamina, and increased buoyancy that also make the fish more likely to be passively transported by currents (Saunders 1965, Folmar and Dickhoff 1980, Smith 1982). In general, smoltification is timed to be completed as fish are near the fresh water to salt water transition. Too long a migration delay after the process begins is believed to cause the fish to miss the "biological window" of optimal physiological condition for the transition (Walters et al. 1978). The optimal thermal range for chinook during smoltification and seaward migration is 50° F to 55° F (Rich 1997).

Chinook salmon spend between one and four years in the ocean before returning to their natal streams to spawn (Myers et al. 1998). Fisher (1994) reported that 87% of returning spring-run adults are three-years-old based on observations of adult chinook trapped and examined at Red Bluff Diversion Dam between 1985 and 1991.

Central Valley Spring-run Chinook Designated Critical Habitat

On February16, 2000, NMFS designated critical habitat for the Central Valley spring-run chinook salmon ESU (63 FR 11482). Critical habitat consists of the water, substrate, and adjacent riparian zone of accessible estuarine and riverine reaches. Accessible reaches are those within the historical range of the Central Valley spring-run chinook ESU that can still be occupied by any life stage of chinook salmon. Inaccessible reaches are those above longstanding, naturally impassable barriers (i.e., natural waterfalls in existence for at least several hundred years) and specific dams within the historical range of each ESU. Adjacent riparian zones are defined as the area adjacent to a stream that provides the following functions: shade, sediment transport, nutrient or chemical regulation, streambank stability, and input of large woody debris or organic matter.

Critical habitat for Central Valley spring-run chinook is designated to include all river reaches accessible to chinook salmon in the Sacramento River and its tributaries in California. Also included are river reaches and estuarine areas of the Sacramento-San Joaquin Delta, all waters from Chipps Island westward to Carquinez Bridge, including Honker Bay, Grizzly Bay, Suisun Bay, and Carquinez Strait, all waters of San Pablo Bay westward of the Carquinez Bridge, and all waters of San Francisco Bay (north of the San Francisco/Oakland Bay Bridge) from San Pablo Bay to the Golden Gate Bridge. Excluded are areas above specific dams or above longstanding naturally impassable barriers.

Central Valley Steelhead - Threatened: Population Trends, Life History, and Biological Requirements

Effective May 18, 1999, NMFS listed Central Valley steelhead as threatened under the Endangered Species Act (63 FR 13347). Central Valley steelhead once ranged throughout most of the tributaries and headwaters of the Sacramento and San Joaquin basins prior to dam construction, water development, and watershed perturbations of the 19th and 20th centuries (McEwan and Jackson 1996). Historical documentation exists that show steelhead were once widespread throughout the San Joaquin River system (CALFED 1999). In the early 1960s, the California Fish and Wildlife Plan estimated a total run size of about 40,000 adults for the entire Central Valley including San Francisco Bay (DFG 1965). The annual run size for this ESU in 1991-92 was probably less than 10,000 fish based on dam counts, hatchery returns and past spawning surveys (McEwan and Jackson 1996).

Estimates of steelhead historical habitat can be based on estimates of salmon historical habitat. The extent of habitat loss for steelhead is probably greater than losses for salmon, because steelhead go higher into the drainages than do chinook salmon (Yoshiyama et al. 1996). Clark (1929) estimated that originally there were 6,000 miles of salmon habitat in the Central Valley system and that 80% of this habitat had been lost by 1928. Yoshiyama et al. (1996) calculated that roughly 2,000 miles of salmon habitat was actually available before dam construction and mining, and concluded that 82% of what was present is not accessible today. Clark (1929) did not give details about his calculation. Whether Clark's or Yoshiyama's calculation is used, only remnants of the former steelhead range remain accessible today in the Central Valley.

As with Central Valley spring-run chinook, impassable dams block access to most of the historical headwater spawning and rearing habitat of Central Valley steelhead. In addition, much of the remaining, accessible spawning and rearing habitat is severely degraded by elevated water temperatures, agricultural and municipal water diversions, unscreened and poorly screen water intakes, restricted and regulated streamflows, levee and bank stabilization, and poor quality and quantity of riparian and SRA cover.

At present, wild steelhead stocks appear to be mostly confined to upper Sacramento River tributaries such as Antelope, Deer, and Mill creeks and the Yuba River (McEwan and Jackson 1996). Naturally spawning populations are also known to occur in Butte Creek, and the upper Sacramento, Feather, American, Mokelumne, and Stanislaus rivers (CALFED 1999). However, the presence of naturally spawning populations appears to correlate well with the presence of fisheries monitoring programs, and recent implementation of new monitoring efforts has found steelhead in streams previously thought not to contain a population, such as Auburn Ravine, Dry Creek, and the Stanislaus River. It is possible that other naturally spawning populations exist in Central Valley streams, but are undetected due to lack of monitoring or research programs (IEP Steelhead Project Work Team 1999).

All Central Valley steelhead are currently considered winter-run steelhead (McEwan and Jackson 1996), although there are indications that summer steelhead were present in the Sacramento River system prior to the commencement of large-scale dam construction in the 1940's (IEP Steelhead Project Work Team 1999). Adult steelhead migrate upstream in the Sacramento River mainstem from July through March, with peaks in September and February (Bailey 1954; Hallock et al. 1961). The timing of upstream migration is generally correlated with higher flow events, such as freshets or sand bar breaches, and associated lower water temperatures. The preferred temperatures for upstream migration are between 46° F and 52° F (Reiser and Bjornn 1979, Bovee 1978, Bell 1986). Unusual stream temperatures during upstream migration periods can alter or delay migration timing, accelerate or retard mutations, and increase fish susceptibility to diseases. The minimum water depth necessary for successful upstream passage is 18 cm (Thompson 1972). Velocities of 3-4 meters per second approach the upper swimming ability of steelhead and may retard upstream migration (Reiser and Bjornn 1979).

Spawning may begin as early as late December and can extend into April with peaks from January through March (Hallock et al. 1961). Unlike chinook salmon, not all steelhead die after spawning. Some may return to the ocean and repeat the spawning cycle for two or three years; however, the percentage of repeat spawners is generally low (Busby et al. 1996). Steelhead spawn in cool, clear streams featuring suitable gravel size, depth, and current velocity. Intermittent streams may be used for spawning (Barnhart 1986; Everest 1973). Gravels of 1.3 cm to 11.7 cm in diameter (Reiser and Bjornn 1979) and flows of approximately 40-90 cm/second (Smith 1973) are generally preferred by steelhead. Reiser and Bjornn (1979) reported that steelhead prefer a water depth of 24 cm or more for spawning. The survival of embryos is reduced when fines of less than 6.4 mm comprise 20 - 25% of the substrate. Studies have shown a survival of embryos improves when intragravel velocities exceed 20 cm/hour (Phillips and Campbell 1961, Coble 1961). The preferred temperatures for spawning are between 39° F and 52° F (McEwan and Jackson 1996).

Length of time required for eggs to develop and hatch is dependant on water temperature and is quite variable; hatching varies from about 19 days at an average temperature of 60° F to about 80 days at an average of 42° F. The optimum temperature range for steelhead egg incubation is 46° F to 52° F (Reiser and Bjornn 1979, Bovee 1978, Bell 1986, Leidy and Li 1987). Egg mortality may begin at temperatures above 56° F (McEwan and Jackson 1996).

After hatching, pre-emergent fry remain in the gravel living on yolk-sac reserves for another four to six weeks, but factors such as redd depth, gravel size, siltation, and temperature can speed or retard this time (Shapovalov and Taft 1954). Upon emergence, steelhead fry typically inhabit shallow water along perennial stream banks. Older fry establish territories which they defend. Streamside vegetation is essential for foraging, cover, and general habitat diversity. Steelhead juveniles are usually associated with the bottom of the stream. In winter, they become inactive and hide in available cover, including gravel or woody debris.

The majority of steelhead in their first year of life occupy riffles, although some larger fish inhabit pools or deeper runs. Juvenile steelhead feed on a wide variety of aquatic and terrestrial insects, and emerging fry are sometimes preyed upon by older juveniles. Water temperatures influence the growth rate, population density, swimming ability, ability to capture and metabolize food, and ability to withstand disease of these rearing juveniles. Rearing steelhead juveniles prefer water temperatures of 45° F to 60° F (Reiser and Bjornn 1979, Bovee 1978, Bell 1986). Temperatures above 60° F have been determined to induce varying degrees of chronic stress and associated physiological responses in juvenile steelhead (Leidy and Li 1987).

After spending one to three years in freshwater, juvenile steelhead migrate downstream to the ocean. Most Central Valley steelhead migrate to the ocean after spending two years in freshwater (Hallock et al. 1961, Hallock 1989). Barnhart (1986) reported that steelhead smolts in California range in size from 14 to 21 cm (fork length). In preparation for their entry into a saline environment, juvenile steelhead undergo physiological transformations known as smoltification that adapt them for their transition to salt water. These transformations include different swimming behavior and proficiency, lower swimming stamina, and increased buoyancy that also make the fish more likely to be passively transported by currents (Saunders 1965, Folmar and Dickhoff 1980, Smith 1982). In general, smoltification is timed to be completed as fish are near the fresh water to salt water transition. Too long a migration delay after the process begins is believed to cause the fish to miss the "biological window" of optimal physiological condition for the transition (Walters et al. 1978). The optimal thermal range during smoltification and seaward migration for steelhead is 44° F to 52° F (Leidy and Li 1987, Rich 1997) and temperatures above 55.4° F have been observed to inhibit formation and decrease activity of gill (Na and K) ATPase activity in steelhead, with concomitant reductions in migratory behavior and seawater survival (Zaugg and Wagner 1973, Adams et. al 1975). Hallock et al. (1961) found that juvenile steelhead in the Sacramento Basin migrated downstream during most months of the year, but the peak period of emigration occurred in the spring, with a much smaller peak in the fall.

Steelhead spend between one and four years in the ocean (usually one to two years in the Central Valley) before returning to their natal streams to spawn (Barnhart 1986, Busby et al. 1996).

Central Valley Steelhead Designated Critical Habitat

On February16, 2000, NMFS designated critical habitat for the Central Valley steelhead evolutionarily significant unit (ESU) (63 FR 11482). Critical habitat consists of the water, substrate, and adjacent riparian zone of accessible estuarine and riverine reaches. Accessible reaches are those within the historical range of the Central Valley steelhead ESU that can still be occupied by any life stage of steelhead. Inaccessible reaches are those above longstanding, naturally impassable barriers (i.e., natural waterfalls in existence for at least several hundred years) and specific dams within the historical range of each ESU. Adjacent riparian zones are defined as the area adjacent to a stream that provides the following functions: shade, sediment transport, nutrient or chemical regulation, streambank stability, and input of large woody debris or organic matter. Critical habitat for Central Valley steelhead is designated to include all river reaches accessible to listed steelhead in the Sacramento and San Joaquin Rivers and their tributaries in California. Also included are river reaches and estuarine areas of the Sacramento-San Joaquin Delta, all waters from Chipps Island westward to Carquinez Bridge, including Honker Bay, Grizzly Bay, Suisun Bay, and Carquinez Strait, all waters of San Pablo Bay westward of the Carquinez Bridge, and all waters of San Francisco Bay (north of the San Francisco/Oakland Bay Bridge) from San Pablo Bay to the Golden Gate Bridge. Excluded are areas of the San Joaquin River upstream of the Merced River confluence and areas above specific dams or above longstanding naturally impassable barriers.

IV. ENVIRONMENTAL BASELINE

The environmental baseline is an analysis of the effects of past and ongoing human and natural factors leading to the current status of the species, its habitat, and ecosystem within the action area (USFWS and NMFS 1998).

A. Status of the Listed Species and Designated Critical Habitat in the Action Area

Spring-run chinook. A significant portion of the Central Valley spring-run chinook salmon ESU spawn and rear in upstream reaches of the action area. Since the majority of spring-run chinook historical spawning and rearing habitat in the Sacramento and San Joaquin River basins is no longer accessible due to impassable dams, the accessible areas of the Feather River, Clear Creek, and upper Sacramento River represent an essential portion of the remaining range and designated critical habitat for Central Valley spring-run chinook salmon.

Historically, the Sacramento River downstream of Shasta Dam was used by spring-run as a migration route to and from cooler tributary streams. After the construction of Keswick Dam in May 1942, Moffett (1947) estimated that 25,000 spring-run spawned in this area of the mainstem

Sacramento River. From 1947 until 1956, estimates of spring-run abundance in the Sacramento River were based on redd counts and ranged from 27,000 to 4,000 (DFG 1998). No estimates were made from 1957 through 1968. Starting in 1969, spring-run estimates were based on counts made at Red Bluff Diversion Dam (RBDD) which included fish that were destined for Battle and Cottonwood Creeks. Since estimates of spring-run escapements are also separately generated for these drainages, some fish are "double counted" and no analysis has been performed to adjust the RBDD estimates to account strictly for the spawners to the mainstem Sacramento River. From 1991-1997, counts at RBDD have been below 800 spring-run and in 1997 had declined to 189 fish.

Over the past several decades, no records were made regarding spring-run chinook in Clear Creek. Azevedo and Parkhurst (1958) mentioned seeing spring-run in 1956 for the first time in Clear Creek since 1949, but gave no estimate. Due to passage problems associated with the McCormick-Saeltzer Dam (creek mile 6.5) and less than desirable habitat conditions below this dam for spring-run, it was believed that spring-run would not use Clear Creek. However, FWS and DFG snorkel surveys during May through August of 1999, identified 35+ adult chinook salmon in Clear Creek (unpublished data). Phenotypic indicators suggest most, if not all, of these salmon observed were spring-run chinook salmon.

Prior to complete blockage of the upper Feather River by the Oroville Dam in 1964, the spring-run population in the Feather River varied from a low of 500 fish in 1957 (Mahoney 1958) to a high of 4,000 in 1959 (Mahoney 1960) based on spawning area surveys, live counts, and/or aerial redd surveys. Following construction of Oroville Dam, the spring-run population has varied from an all-time low of 146 fish in 1967 (Menchen 1968) to a high of 6,833 in 1988 (Schlicting 1991) based on estimates generated according to the number of fish entering the Feather River fish hatchery. Coded-wire-tag information from these hatchery returns indicates substantial introgression has occurred between fall-run and spring-run chinook populations in the Feather River due to hatchery practices.

Due to poor estimates of run size and large variations in annual escapements between Central Valley streams, the percentage of the ESU spawning and rearing within the action area can not be determined. However, the upper Sacramento River, Feather River, and Clear Creek represent approximately one-quarter of the remaining spawning streams in the Central Valley.

All of the emigrating juvenile sub-yearling and yearling Central Valley spring-run chinook use the lower reach of the Sacramento River and the Delta for rearing and as migration corridor to the ocean. Some juveniles utilize tidal and non-tidal freshwater marshes and other shallow water areas in the Delta as rearing areas for short periods prior to the final portion of their emigration to the sea. All adult spring-run chinook salmon use the Delta and lower Sacramento River as an upstream migration corridor to return to their natal streams for spawning.

Central Valley spring-run chinook populations within the action area generally show a continuing population decline, an overall low population abundance, and fluctuating return rates. These demographics for Central Valley spring-run chinook indicate the long-term viability of the ESU is at risk.

The action area is located within the designated critical habitat of Central Valley spring-run chinook. Designated critical habitat within the action area ranges from riverine habitat to estuarine areas. The essential elements of critical habitat in these areas are the water, substrate, and adjacent riparian areas.

Central Valley Steelhead. As with Central Valley spring-run chinook, a significant portion of the Central Valley steelhead ESU spawn and rear in streams within the action area. These streams include the Feather River, Clear Creek, upper Sacramento River, American River, and the Stanislaus River. Since the majority of Central Valley steelhead historical spawning and rearing habitat in the Sacramento and San Joaquin River basins is no longer accessible due to impassable dams, the accessible areas of the Feather River, Clear Creek, upper Sacramento River, American River and the Stanislaus River represent an essential portion of the remaining range and designated critical habitat for this steelhead ESU.

Central Valley steelhead populations within the action area generally show a continuing population decline, an overall low population abundance, and fluctuating return rates. Historical abundance estimates are available for some stocks within the action area but no overall reliable estimates are available. Monitoring of steelhead populations in the Sacramento and its tributaries is limited to the direct counts made at the RBDD, Feather River Fish Hatchery, and Nimbus Fish Hatchery. At the RBDD in the upper Sacramento River, counts have averaged 1,400 fish over the last 5 years, compared with runs in excess of 10,000 in the late 1960s. The RBDD data indicates a decline of 9 percent per year from 1966 to 1992. In the Feather River, hatchery returns averaged 858 fish in the 1967-1991 period with an increasing trend from an average of 790 in the first five years of the period to 1,386 fish in the last five years of the period (USBR 1997). In the American River, recent estimates of hatchery produced steelhead average less than 1,000 fish, compared to 12,000-19,000 in the early 1970s (McEwan and Jackson 1996). Steelhead have been reported in Clear Creek below the McCormick-Saeltzer Dam. However, the creek has not been surveyed for spawning adults for several years, so the current abundance is unknown but presumed low (McEwan and Jackson 1996). There is no information regarding population size on the Stanislaus River, however, a small remnant run of steelhead persists based on observations of smolt outmigrants during the last several years.

All emigrating juvenile Central Valley steelhead smolts use the lower reaches of the Sacramento and San Joaquin rivers and the Delta for rearing and as migration corridor to the ocean. Some juveniles may utilize tidal and non-tidal freshwater marshes and other shallow water areas in the Delta as rearing areas for short periods prior to the final portion of their emigration to the sea. All adult steelhead use the Delta and lower reaches of the Sacramento and San Joaquin rivers as an upstream migration corridor to return to their natal streams for spawning.

The action area is located within the designated critical habitat of the Central Valley steelhead. Designated critical habitat within the action area ranges from riverine habitat to estuarine areas. The essential elements of critical habitat in these areas are the water, substrate, and adjacent riparian areas.

B. Factors Affecting Species Environment within the Action Area

The essential features of freshwater salmonid habitat include adequate (1) substrate; (2) water quality; (3) water quantity; (4) water temperature; (5) water velocity; (6) cover/shelter; (7) food; (8) riparian vegetation; (9) space; and (10) safe passage conditions. These features have been affected by human activities such as water management, flood control, agriculture, and urban development throughout the action area. Impacts to these features have led to salmonid population declines significant enough to warrant the listing of several salmonid species in the Central Valley of California.

High water quality and quantity are essential for survival, growth, reproduction, and migration of individuals dependent on riparian and aquatic habitats. Important water quality elements include flows adequate to support the migratory, rearing, and emergence needs of fish and other aquatic organisms. Desired flow conditions for salmonids include an annual abundance of cool, well-oxygenated water with low levels of suspended and deposited sediments or other pollutants that could limit primary production and/or invertebrate abundance and diversity.

Habitat Impacts in the Sacramento- San Joaquin River Basins. Profound alterations to the riverine habitat of the Central Valley began with the discovery of gold in the middle of the last century. Dam construction, water diversion, and hydraulic mining soon followed, launching the Central Valley into the era of water manipulation and coincident habitat degradation.

About 150 years ago, the Sacramento River was bordered by up to 500,000 acres of riparian forest, with bands of vegetation literally spreading four to five miles (Resources Agency 1989). By 1979, riparian habitat along the Sacramento River diminished to 11,000-12,000 acres or about 2 percent of historic levels (McGill 1979). More recently, about 16,000 acres of remaining riparian vegetation has been reported (McGill 1987). The degradation and fragmentation of riparian habitat has resulted mainly from flood control and bank protection projects, together with the conversion of riparian land to agriculture (Jones and Stokes Associates 1993). In addition, alteration of the Sacramento River's natural flow regime following construction of Shasta Dam has impaired the regeneration of riparian vegetation. Historically, the seasonal flow patterns included high flood flows in the winter and spring with declining flows throughout the summer and early fall. As flows declined during the summer, the seeds from willows and cottonwood trees, deposited on the recently created sand bars, would germinate, sprout, and grow to maturity. The roots of these plants would follow the slowly receding water table, allowing the plants to become firmly established before the next rainy season. Similar habitat impacts have occurred on Clear Creek, and the Feather, American, and Stanislaus Rivers.

Hydropower and flood control dams of the CVP and SWP have permanently blocked or hindered salmonid access to historical spawning and rearing grounds. Downstream effects of these dams include significant alteration of flow regimes, riparian functions and quality, and primary productivity of the stream. Diversion and storage of natural flows have altered the natural cycles by which juvenile and adult salmonids base their migrations and have also depleted river flows. Depleted flows have contributed to higher temperatures, lower dissolved oxygen levels, and decreased gravel and large woody debris recruitment.

Increased sedimentation resulting from agricultural and urban practices within the Central Valley is a primary cause of salmonid habitat degradation. Sedimentation has adversely impacted salmonids during all freshwater life stages by clogging, or abrading gill surfaces; adhering to eggs; inducing behavioral modifications; burying eggs or alevins; scouring and filling pools and riffles; reducing primary productivity and photosynthetic activity; and affecting intergravel permeability and dissolved oxygen levels. Embedded substrates have reduced the production of juvenile salmonids and hindered the ability of some over-wintering juveniles to hide in the gravels during high flow events. Increased sedimentation has also been shown to increase water temperatures, thereby directly impacting incubating and rearing salmonids.

Land use activities associated with road construction, urban development, logging, mining, agriculture, and recreation have significantly altered fish habitat quantity and quality through alteration of streambank and channel morphology; alteration of ambient stream water temperatures; degradation of water quality; elimination of spawning and rearing habitat; fragmentation of available habitats; elimination of downstream recruitment of gravel and large woody debris; and removal of riparian vegetation resulting in increased streambank erosion. Agricultural practices have eliminated large trees and logs and other woody debris that would have been otherwise recruited to the stream channel. Large woody debris influences stream morphology by affecting pool formation, channel pattern and position, and channel geometry. In addition, unscreened water diversions for agriculture and municipal use have adversely affected salmonids through direct entrainment of emigrating juveniles.

Preliminary, significant steps towards the largest ecological restoration project yet undertaken in the United States have occurred during the past four years and continue to proceed in California's Central Valley. The CALFED Program and the CVPIA's AFRP, in coordination with other Central Valley efforts, have implemented numerous habitat restoration actions that benefit Central Valley steelhead, Central Valley spring-run chinook salmon, and their designated critical habitat. These restoration actions include the installation of fish screens, modification of barriers to improve fish passage, and habitat acquisition and restoration. The majority of these recent restoration actions address key factors for decline of these ESUs and emphasis has been placed in tributary drainages with high potential for steelhead and spring-run chinook production. Additional actions that are currently underway that benefit Central Valley steelhead and Central Valley spring-run chinook include new efforts to enhance fisheries monitoring and conservation actions to address artificial propagation.

A beneficial action unrelated to the CALFED Program or AFRP includes the Environmental Protection Agency's remedial actions at Iron Mountain Mine. The completion of a state-of-the-art lime neutralization plant is successfully removing significant concentrations of toxic metals in acidic mine drainage from the Spring Creek Watershed. Containment loading into the upper Sacramento River from Iron Mountain Mine has shown measurable reductions since the early

1990's.

Habitat Impacts in the Sacramento-San Joaquin Delta. The Sacramento River Basin provides approximately 75 percent of the water flowing into the Delta while the San-Joaquin River Basin and eastside tributaries provide the remainder (DWR 1993). With the completion of upstream reservoir storage projects throughout the Central Valley, the seasonal distribution of flows into the Delta differs substantially from historical patterns. The magnitude and duration of peak flows during the winter and spring are reduced by water impoundment in upstream reservoirs. Instream flows during the summer and early fall months have increased over historic levels for deliveries of municipal and agricultural water supplies. Overall, water management now reduces natural variability by creating more uniform flows year-round.

Juvenile salmon migrate downstream from their upper river spawning and nursery grounds to lower river reaches and the Delta prior to entering the ocean as smolts. To a great extent, streamflow volume and runoff patterns regulate the quality and quantity of habitat available to juvenile salmonids. Salmon are highly adapted to seasonal changes in flow. Increased stream flows in the fall and winter stimulate juvenile salmonid downstream migration, improve rearing habitat, and improve smolt survival to the ocean. Changes in runoff patterns from upstream reservoir storage to the Delta have adversely affected Central Valley salmonids, including spring-run chinook salmon and steelhead, through reduced survival of juvenile fish.

Historically, the tidal marshes of the Delta provided a highly productive estuarine environment for juvenile anadromous salmonids. During the course of their downstream migration, juvenile spring-run chinook and steelhead utilize the Delta's estuarine habitat for seasonal rearing, and as a migration corridor to the sea. Since the 1850's, reclamation of Delta islands for agricultural purposes caused the cumulative loss of 94 percent of the Delta's tidal marshes (Monroe and Kelly 1992).

In addition to the degradation and loss of estuarine habitat, downstream migrant juvenile salmon in the Delta have been subject to adverse conditions created by water export operations at the CVP/SWP. Specifically, juvenile salmon have been adversely affected by: (1) water diversion from the mainstem Sacramento River into the Central Delta via the manmade Delta Cross Channel, Georgiana Slough, and Three-mile Slough; (2) upstream or reverse flows of water in the lower San Joaquin River and southern Delta waterways; and (3) entrainment at the CVP/SWP export facilities and associated problems at Clifton Court Forebay. In addition, salmonids are exposed to increased water temperatures from late spring through early fall in the lower Sacramento River and San Joaquin River reaches and the Delta. These temperature increases are primarily caused by the loss of riparian shading, and by thermal inputs from municipal, industrial, and agricultural discharges.

Recent habitat restoration initiatives sponsored and funded primarily by the CALFED Program have resulted in plans to restore ecological function to over several thousands acres of habitat within the Delta. During the past three years, approximately 1,500 acres of land have been purchased for restoration activities. Restoration of these areas primarily involves flooding lands previously used for agriculture, thereby creating additional rearing habitat for juvenile salmonids.

V. ASSESSMENT OF IMPACTS

For purposes of this Opinion, the water year 2000 (50% and 90% exceedance) forecasts from a November 4, 1999, workshop are used to assess the impacts to listed species covered under this opinion. Also, the temperatures predicted for 1999 are used for the predicted temperatures in January through March 2000, since they are expected to be similar. Both the flow and temperature forecasts are based on monthly models, therefore, daily flow release and daily temperatures can fluctuate from the monthly values.

Clear Creek

Adult Migration, Spawning, and Incubation

From December 1999, through March 2000, Reclamation proposes to release 200 cfs from Whiskeytown Reservoir to Clear Creek under the 50% exceedence forecast. Under the 90% exceedence forecast, Reclamation proposes to release 200 cfs from Whiskeytown Reservoir to Clear Creek in December 1999 and to release 150 cfs to Clear Creek during January, February, and March, 2000. This release schedule is consistent with the AFRP flow targets for Clear Creek. The AFRP flow targets are within the average total annual unimpaired flows to the Clear Creek watershed. Predicted monthly average temperatures at the mouth of Clear Creek during the period of January 1999- March 1999 and December 1999, range from 43.9°F to 47.9°F under both exceedance forecasts. Temperatures upstream of the mouth in Clear Creek are predicted to be slightly cooler.

Steelhead adults will be migrating upstream from the Sacramento River into Clear Creek during December through March to spawn. Upstream migration and spawning will generally be limited to the reach of Clear Creek downstream of McCormick Saeltzer Dam (creek mile 6.5) due to a poorly functioning fish ladder at the dam. Based on observations in the Sacramento River, steelhead spawning typically occurs from December through April with peak activity occurring from January through March (Hallock et al. 1961, as cited in McEwan and Jackson 1996). Flows in Clear Creek ranging from 150 to 200 cfs are expected to provide adequate depths and velocities for upstream passage of steelhead adults and predicted temperature conditions are within the range of preferred spawning temperatures.

Egg incubation to emergence of steelhead fry can take as little as eight to ten weeks to occur after fertilization depending on redd depth, gravel size, siltation, and temperature (Leitritz and Lewis 1980, Shapovalov and Taft 1954, as cited in McEwan and Jackson 1996). Accordingly, emergence may occur anytime from approximately mid-February through May. Predicted monthly average temperatures at the mouth of Clear Creek are below the range of preferred incubating and emergence temperatures (48°F to 52°F) from December through March. Cooler temperatures during these months are likely to slow the development of incubating eggs and pre-emergent fry resulting in a longer incubation period. For spring-run chinook salmon, spawning primarily occurred during September and emergence of fry from redds is predicted for December and January based on predicted temperatures.

During December through March, large flow releases from Whiskeytown Dam to Clear Creek may be required for short durations by Reclamation for flood control and safety of dams criteria. For example, flows on February 6, 1999, increased from 240 cfs to 2,900 cfs within 24 hours and then dropped back to 520 cfs within the next 48 hours. Short duration, high flow events of this nature have the potential to scour steelhead redds and result in the injury and mortality of steelhead eggs and sac-fry. These adverse effects may occur to spring-run chinook salmon during December and January as well.

Snorkel surveys conducted by FWS and DFG during the summer of 1999, identified 35+ adult chinook salmon in Clear Creek between Whiskeytown Dam and the confluence with the Sacramento River. All of these fish but one were observed below McCormick-Saeltzer Dam. One adult female chinook was observed 1.6 miles upstream of McCormick-Saeltzer Dam on August 19, 1999. Although fish ladder improvements at McCormick-Saeltzer Dam in the early 1990's may have improved conditions, these survey results confirm significant problems for upstream fish passage remain.

Phenotypic indicators suggest most, if not all, of the adult chinook salmon observed in Clear Creek during the 1999 surveys are spring-run chinook salmon. These fish began spawning in September 1999, and emergence of fry is expected during December and January. Relatively stable releases from Whiskeytown Dam during the period of September through November provided flow conditions which avoided scouring and dewatering of redds. On September 7, 1999, and again on September 10, 1999, Reclamation increased flows in Clear Creek in 50 cfs increments to improve temperature conditions for spawning and incubating spring-run chinook. Water temperatures generally dropped by 1°F in lower Clear Creek within 48 hours in response to each flow increase. Reclamation's temperature control efforts in September 1999, avoided significant losses of spring-run chinook eggs and larvae below McCormick-Saeltzer Dam. However, the resulting temperatures of 57°F to 60°F during September may have reduced the survival of some eggs and pre-emergent spring-run chinook in Clear Creek.

Fry, Juveniles, and Smolts

For fry and juvenile steelhead and spring-run chinook, water temperatures between 45°F and 60°F for steelhead and between 50°F to 60°F for spring-run chinook are preferred for growth and development. Predicted monthly average temperatures in Clear Creek from December through March are either slightly below or within the preferred temperature range for steelhead and are below preferred temperatures for spring-run chinook.

Reclamation does not propose ramping criteria for increasing or decreasing Whiskeytown releases to Clear Creek. As presented in the example above, flows in Clear Creek may increase and decrease rapidly in response to Whiskeytown Reservoir flood control or safety of dams criteria. Strandings of fry and juvenile steelhead and spring-run chinook may occur in areas that are not connected to the creek except during periods of high flows. Juvenile salmon have been observed in pools isolated from Clear Creek when flows recede (Matt Brown, USFWS, personal communication 1999). If no additional high flow events follow within a short period of time, stranded fish may be lost to predation, lethal water temperature conditions, or dessication.

Based on emigration patterns of steelhead in the upper Sacramento River, steelhead juveniles and smolts may emigrate downstream and out of Clear Creek from October through early July (McEwan and Jackson, 1996; SWRI 1997, as cited in DWR and Reclamation 1999). Predicted flows in Clear Creek are expected to provide suitable depths and velocities for juvenile steelhead rearing and emigration between December and March. Predicted water temperatures in Clear Creek are expected to be within, or below, preferred temperatures for juvenile steelhead rearing and emigration between December and March.

Spring-run chinook salmon juveniles in the Sacramento River Basin exhibit two different life history strategies. Most juveniles enter saltwater as subyearlings and are typically migrating downstream 60-150 days post-hatching during the spring. Other juveniles remain in freshwater through the spring and summer months and emigrate the following fall as yearlings. Emigration of yearling spring-run chinook juveniles from the upper Sacramento River and its tributaries typically occurs October through March, with peak movement in November and December (DFG 1998). In Clear Creek, both juvenile life history strategies may be represented. Predicted flows in Clear Creek are expected to provide suitable depths and velocities for juvenile spring-run chinook rearing and emigration between December and March. Predicted water temperatures in Clear Creek are expected to be within, or below, preferred temperatures for juvenile spring-run chinook rearing and emigration between December and March.

Sacramento River

Adult Migration, Spawning, and Incubation

From December 1999, through March 2000, Reclamation proposes to release on average 6,600 to 7,000 cfs from Keswick Dam to the upper Sacramento River under the 50% exceedence forecast and 4,000 to 5,000 cfs under the 90% exceedence forecast. Actual daily releases may fluctuate from these monthly averages, particularly during flood control operations. Minimum releases from Keswick Dam will not drop below 3,250 cfs. This flow schedule is consistent with the AFRP flow targets for the upper Sacramento River. Predicted monthly average temperatures between Keswick Dam and Red Bluff during the period of December 1999, through March 2000, generally range from 46°F to 53°F under both exceedence forecasts.

Steelhead adults will be migrating upstream in the Sacramento River during the period between December and March to spawn. Specific information regarding steelhead spawning within the Sacramento River is limited. However, adult steelhead in the Sacramento River Basin are expected to typically spawn from December through April with peak activity occurring from January through March (Hallock et al. 1961, as cited in McEwan and Jackson 1996). Keswick Dam releases of 3,250 to 7,000 cfs combined with tributary accretions are expected to provide adequate depths and velocities for upstream passage of migrating adults and for spawning. Predicted average monthly temperatures are within the range of preferred spawning temperatures for steelhead.

The extent of spring-run chinook spawning in the mainstem of the upper Sacramento River is unknown. Spring-run chinook are thought to move above RBDD towards Keswick Dam as they seek cooler water within the suitable temperature range for spawning (<56°F). Spring-run chinook adults in the upper Sacramento River spawned primarily in September 1999, and emergence of fry is expected during December and January. Relatively stable releases from Keswick Dam during the period of September through November 1999, provided flow conditions which avoided scouring and dewatering of redds. Daily average water temperatures between Keswick and Bend Bridge were generally below 56°F and, thus, within the preferred range for chinook salmon spawning and incubation.

Predicted monthly average temperatures in the upper Sacramento River are generally below or within the range of suitable incubating and emergence temperatures (48°F to 52°F) from December through March. Cooler temperatures during these months are likely to slow the development of incubating eggs and pre-emergent fry resulting in a longer incubation period. For spring-run chinook salmon, spawning primarily occurred during September and emergence of fry from redds is predicted for December and January.

During the period of steelhead egg and larval incubation (includes December through March), some large flow releases from Shasta and Keswick dams to the upper Sacramento River may be required for flood control and safety of dams criteria. Extremely high flow events have the potential to scour steelhead redds and result in the injury and mortality of steelhead eggs and sac-fry. Redds constructed during high flow releases may be dewatered when releases return to the projected forecast schedule. However, most releases made from Shasta Dam to avoid encroachment into the reservoir flood pool are not expected to scour or damage steelhead redds. The extent of redds lost or damaged by dewatering is expected to be minimal under most circumstances unless very high flows are sustained for several weeks followed by the minimum release of 3,250 cfs. Adverse effects may occur to spring-run chinook sac-fry during December and January as well.

Fry, Juveniles, and Smolts

For fry and juvenile steelhead and spring-run chinook, water temperatures between 45°F and 60°F for steelhead and between 50°F to 60°F for spring-run chinook are preferred for growth and development. Predicted monthly average temperatures in the mainstem Sacramento River from December through March are within the preferred temperature range for rearing steelhead and are either slightly below or within preferred temperatures for rearing spring-run chinook.

The ramping criteria for Keswick Dam releases to the Sacramento River established in the WR Opinion remains in effect through March 31. This ramping criteria is expected to minimize or eliminate impacts to steelhead and spring-run chinook fry and juveniles from stranding and dewatering. Ramping down of flows occurs primarily at night when fish are typically more active and less likely to become isolated in pools or side channels. In addition, releases are reduced at very slow rates over several nights allowing adequate opportunities for fish to pass from shallow nearshore areas and pools into the mainstem of the river.

Steelhead juveniles and smolts may emigrate from the upper Sacramento River over a prolonged period (October through early July) (McEwan and Jackson, 1996; SWRI 1997, as cited in DWR and Reclamation 1999). Spring-run yearlings may emigrate from the upper Sacramento beginning in October and extend through February while sub-yearlings may begin in December and continue through May. Predicted monthly average temperatures in the upper Sacramento River are within the preferred smoltification temperatures for juvenile steelhead and spring-run chinook salmon from December through March. Also, predicted flows within the upper Sacramento River are expected to provide suitable depths and velocities for emigrating juvenile steelhead and spring-run chinook salmon.

American River

Adult Migration, Spawning, and Incubation

From December 1999, through March 2000, Reclamation proposes to release on average 2,500 to 4,000 cfs from Nimbus Dam to the American River under the 50% exceedence forecast and 1,500 to 1,900 cfs under the 90% exceedence forecast. Actual daily releases may fluctuate from these monthly averages, particularly during flood control operations. This flow schedule is consistent with the AFRP flow targets for the lower American River. Predicted monthly average temperatures between Nimbus Dam and the confluence with the Sacramento River during the period of December 1999, through March 2000, generally range from 45°F to 55°F under both exceedence forecasts.

Adult steelhead migration typically occurs in the American River from November through April, and peaks in December through March (McEwan and Jackson, 1996; SWRI 1997, as cited in DWR and Reclamation 1999). Predicted monthly average temperatures in the lower American River are within the range of preferred migrating temperatures (46°F to 52°F) from December through March. Forecasted flow conditions are expected to provide suitable depths and velocities for upstream passage of adults to spawning areas within the lower American River.

Steelhead spawning in the American River typically occurs from December through April (McEwan and Jackson, 1996; SWRI 1997, as cited in DWR and Reclamation 1999). Predicted monthly average temperatures from Nimbus Dam to the mouth of the American River are within the range of preferred spawning temperatures from December through March. Egg incubation to emergence of steelhead fry includes the period from December through March. Predicted monthly average temperatures within the lower American River are either slightly below or within the range of preferred incubating and emergence temperatures (48°F to 52°F) from December through March. Cooler temperatures during these months are likely to slow the development of incubating eggs and pre-emergent fry resulting in a longer time until emergence.

During the period of steelhead egg and larval incubation (includes December through March), large flow releases from Folsom and Nimbus dams to the lower American River may be required by Reclamation for flood control and safety of dams criteria. Extremely high flow events have the potential to scour steelhead redds and result in the injury and mortality of steelhead eggs and sac-fry. Most releases from Folsom Dam to avoid encroachment into the reservoir flood pool will not create high velocity, scouring flow conditions in the Lower American River that are likely to damage steelhead redds. However, redds constructed during high flow releases may be dewatered when releases return to the projected forecast schedule. The extent of steelhead redds lost or damaged by dewatering is not easily quantified, but rapid and large flow fluctuations are known to expose and dry chinook redds in the early winter months (DFG 1993).

Spring-run chinook salmon historically occurred in the South, North and Middle forks of the American River (DFG 1998). Following years of ineffective or absent fish ladders at the historic Folsom Dam, upstream access was completely blocked when the new, present-day Folsom and Nimbus dams were constructed. Due to the absence of cold water pools available in the lower American River for over-summering, spring-run chinook no longer exist in the American River.

Fry, Juveniles, and Smolts

For fry and juvenile steelhead, water temperatures between 45°F and 60°F are preferred for growth and development. Predicted monthly average temperatures in the lower American River from December through March are within the preferred temperature range for this species.

Reclamation proposes to use draft ramping criteria developed by members of the American River Operations Group to reduce the incidence of stranding relative to past operations. Reclamation also proposes to continue providing funds for an ongoing stranding study conducted by DFG to better define criteria for fluctuating flows. Preliminary results of DFG's fish stranding study for the Lower American River indicate that the aquatic habitat most affected by changes in flow below 4,000 cfs tends to be low profile banks and mid-channel bars. A few isolated ponds may be created on these low profile banks and mid-channel bars by reductions in flow from 4,000 cfs to 1,750 cfs. Low profile bars are sensitive to small decreases in stage that can de-water or partially de-water the slopes of the bars. Steelhead fry present along low profile gravel bars or in side channels/pools will generally avoid stranding with the current ramping criteria, but a minimal amount of stranding is expected. Juvenile steelhead, given their size and swimming ability, are expected to have adequate opportunity with the slow ramping rate to leave the affected area in advance of stranding. However, some releases for flood control can not adhere to the draft ramping criteria and streamflows below Nimbus Dam can fluctuate widely during flood control operations. Flow fluctuations currently implemented during flood control operations by the Reclamation may adversely effect fry and juvenile steelhead through stranding on higher terraces and in side channels.

For juvenile steelhead rearing, water temperatures between 45°F and 60°F are preferred for growth and development. Predicted monthly average temperatures are not likely to adversely affect rearing and emigrating juvenile steelhead during the period of December through March. Several years of juvenile salmonid emigration studies in the lower American River indicate large numbers of steelhead fry move downstream from March through June while steelhead yearlings and smolts emigrate from late December through February (Snider et al. 1997, Snider et al. 1998). Predicted flows are expected to provide suitable depth and velocity conditions for emigration. Predicted monthly average temperatures at the mouth of the American River are between 45.9 and 52.0°F from December through March which are within the range of favored steelhead smoltification temperatures.

Stanislaus River

Adult Migration, Spawning, and Incubation

From December 1999, through March 2000, Reclamation proposes to release on average 325 to 350 cfs from New Melones Reservoir to the Stanislaus River under the 50% exceedence forecast and approximately 300 to 350 cfs under the 90% exceedence forecast. Actual daily releases may fluctuate from these monthly averages, particularly during flood control operations. Minimum releases from New Melones will reduce flows in the lower Stanislaus River below 300 cfs. This flow schedule is consistent with the AFRP flow targets for the Stanislaus River. Predicted monthly average temperatures between Goodwin Dam and the confluence with the San Joaquin River during the period of December 1999, through March 2000, generally range between 45°F to 55°F under both exceedence forecasts.

Steelhead adults migrate upstream in the Sacramento River during the period between December and March to spawn and are likely to enter into the Stanislaus River during the same period. Under the 50% and 90% exceedence forecasts, predicted monthly average temperatures during the months of December through March between the mouth of the Stanislaus River and Goodwin Dam (RM 58.5) are generally within the range of preferred migrating temperatures for steelhead (46°F to 52°F). New Melones releases of 300 to 350 cfs are expected to provide adequate depths and velocities for upstream passage of migrating adults.

Specific information regarding steelhead spawning within the Stanislaus River is lacking. Based on observations of fall-run chinook spawning and available habitat, steelhead spawning in the Stanislaus River may occur in the reach between Oakdale (RM 41.2) and Goodwin Dam (RM 58.5). Spawning is likely to occur from December through April with peak activity from January through March. Predicted monthly average temperatures between Oakdale and Goodwin Dam are within the range of preferred spawning temperatures (39°F to 52°F) during this time. New Melones releases of 300 to 350 cfs are expected to provide adequate depths and velocities for steelhead spawning and incubation.

During the period of steelhead egg and larval incubation (includes December through March), large flow releases from New Melones Reservoir to the lower Stanislaus River may be required for flood control and safety of dams criteria. Extremely high flow events have the potential to scour steelhead redds and result in the injury and mortality of steelhead eggs and sac-fry.

However, most releases from New Melones Dam to avoid encroachment into the reservoir flood pool are not expected to scour or damage steelhead redds. Redds constructed during high flow releases may be dewatered when releases return to the projected forecast schedule. The amount of redds lost or damaged by dewatering is expected to be minimal under most circumstances unless very high flows are sustained for several weeks followed by the minimum release of 300 cfs.

Spring-run chinook salmon may have historically ascended the North and Middle forks of the Stanislaus River (DFG 1998). However, spring-run chinook no longer exist in the Stanislaus River due to impassable dams blocking access to historical spawning reaches.

Fry, Juveniles, and Smolts

For fry and juvenile steelhead, water temperatures between 45°F and 60°F are preferred for growth and development. Predicted monthly average temperatures in the lower Stanislaus River from December through March are within the preferred temperature range for steelhead.

In the absence of data regarding ramping of steamflows on the Stanislaus River, FWS has proposed to use ramping criteria developed for the Trinity River for New Melones Dam releases to the lower Stanislaus River because channel characteristics and hydrology are similar. However, this ramping criteria can not be achieved under most flood control operations. Whenever possible, New Melones reservoir is maintained at or near the storage level of its flood control space. When the reservoir is at this elevation and a storm event occurs, additional flows must be released or spilled from New Melones Reservoir through Goodwin Dam into the lower Stanislaus River. Flows can increase significantly in a matter of hours. Once the threat of encroachment to the flood pool is over, flows are reduced to pre-flood releases as soon as possible. Depending on the magnitude and/or duration of these flow fluctuations, there is a potential for fry and juvenile steelhead to become stranded.

Emigration of smolts in the Stanislaus River has been observed from April through June (Cramer 1998), but is likely to occur during December through March as well. The preferred temperatures for smoltification are less than 57°F (McEwan and Jackson 1996) and water temperatures in excess of 55°F inhibit formation and decrease activity of gill (Na and K) ATPase activity in steelhead, with concomitant reductions in migratory behavior and seawater survival (Zaugg and Wagner 1973, Adams et. al 1975). Predicted monthly average temperatures are within the preferred smoltification temperatures for juveniles from December through March. Also, predicted flows within the lower Stanislaus River are expected to provide suitable depths and velocities for smolt emigration.

The proposed fisheries monitoring program by screw trap in the Stanislaus River is expected to capture few juvenile steelhead. Based on past sampling by screw trap at the Oakdale sampling site, approximately 20 to 30 steelhead smolts and pre-smolts may be captured, measured, rated for smolting characteristics, and released below the trapping site. Steelhead fry have not been captured in previous years and few, if any, are expected to be captured in the winter 2000 sampling season. Capture and handling related stress will be minimized by the following procedures: (1) traps will be checked at 12-hour intervals during periods of low debris load and at 6-hour intervals during periods of moderate debris loads; (2) sampling will be suspended by raising the screw trap (non-fishing) during periods of high debris loads; (3) all measured fish will be anesthetized in MS-222; (4) captured fish will be released at different locations each day from immediately behind the trap to 100 yards downstream; and (5) following recovery in a bucket of freshwater, fish will be released within 5-30 minutes of sampling by slowly submerging the holding container underwater. Previous sampling experience with screw traps in the Stanislaus River indicates that all captured steelhead will be maintained in good physical condition and released unharmed back into the river. Although, the Stanislaus River steelhead population is probably low, the expected capture of 20 to 30 juvenile steelhead is expected to have little, if any effect, on the Stanislaus River population due to the low numbers captured and adherence to sampling/handling protocols that minimize stress and harm.

Feather River

Adult Migration, Spawning, and Incubation

From December 1999, through March 2000, DWR proposes to release on average 1,750 to 6,000 cfs from Oroville Dam to the Feather River under the 50% exceedence forecast and a constant 1,750 cfs under the 90% exceedence forecast. Approximately 600 cfs of this release will pass through the Thermalito Diversion Dam Powerplant into the low flow section of the Feather River. The low flow section is approximately 8 miles long and extends from the Fish Barrier Dam downstream to the Thermalito Afterbay Outlet. The remainder of the release to the river will pass through Thermalito Forebay and Afterbay to be released at the Thermalito Afterbay Outlet. Actual daily releases may fluctuate from these monthly averages, particularly during flood control operations. Minimum releases in the Feather River below the Thermalito Afterbay Outlet do not drop below 1,700 cfs. Predicted monthly average temperatures between the Fish Barrier Dam (top of the low flow channel) and the confluence with the Sacramento River during the period of December 1999, through March 2000, generally range from 45°F to 56°F under both exceedence forecasts.

Steelhead adults migrate upstream in the Sacramento River during the period between December and March to spawn and are likely to enter into the Feather River during the same period. Most steelhead return to the Feather River Fish Hatchery and very limited information exists regarding the location, timing and magnitude of steelhead spawning within the river. Observations to date suggest the low flow channel is the primary reach for steelhead spawning (DWR and Reclamation 1999). However, the 14-mile section between the Thermalito Afterbay Outlet and the mouth of Honcut Creek (referred to as the high flow section) supports considerable numbers of fall-run chinook salmon spawners and could support some steelhead spawning. Peak spawning is likely to occur from January through March as it does elsewhere in the Sacramento Basin. Due to the low number of steelhead spawning outside of the Feather River Hatchery, flows of 600 cfs in the low flow channel are expected to provide adequate depths and velocities for upstream passage of migrating adults and for spawning. Predicted average monthly temperatures are within the range of preferred spawning temperatures for steelhead.

Predicted monthly average temperatures in the Feather River are either slightly below or within the range of suitable incubating and emergence temperatures during December 1999 through March 2000. Cooler temperatures than preferred are likely to slow the development of incubating eggs and pre-emergent fry resulting in a longer incubation period.

Based on observations of spring-run immigration in the Sacramento River, spring-run adults are likely to migrate upstream during the period between March and July into the Feather River where they hold in deep cold water pools until spawning begins in mid- to late August. Most pre-spawning spring-run chinook salmon adults hold in the upper three miles of the low flow channel (BA 1999). Cooler temperatures near the upper end of the low flow channel during the summer 1999, provided suitable holding conditions throughout the summer months and provided the coldest water available during September for the initiation of spawning. For spring-run chinook salmon, spawning primarily occurred during September and emergence of fry from redds is predicted for December and January. Stable releases of 600 cfs within the low flow channel during the incubation period of September through November 1999, provided flow conditions which avoided scouring and dewatering of redds.

During the period of steelhead egg and larval incubation (includes December through March), large flow releases from Oroville Dam to the low flow channel of the Feather River may be required for flood control and safety of dams criteria; Oroville Dam releases in excess of 17,000 cfs must be released to the low flow channel because the powerplants associated with the Thermalito Complex have a capacity of approximately 17,000 cfs. High flow events in the low flow channel have the potential to scour steelhead redds and result in the injury and mortality of steelhead eggs and sac-fry. These adverse effects may also occur to incubating spring-run chinook salmon during December and January. Frequently, flood releases from Oroville Dam can be managed at rates below 17,000 cfs and significant flow increases in the low flow channel can be avoided. Downstream of the Thermalito Afterbay Outlet, steelhead redds constructed during high flow releases may be dewatered when releases return to the projected forecast schedule. The extent of redds lost or damaged by dewatering below Thermalito is expected to be minimal under most circumstances, because the majority of steelhead are thought to spawn in the low flow channel.

Fry, Juveniles, and Smolts

For fry and juvenile steelhead and spring-run chinook, water temperatures between 45°F and 60°F are preferred for growth and development. Predicted monthly average temperatures in the mainstem Feather River from December through March are slightly below or within the preferred temperature range for both species.

Ramping criteria for the Feather River were established by a 1983 agreement between DWR and DFG. This agreement requires flows below Thermalito Afterbay that are under 2,500 cfs to be reduced by no more than 200 cfs during any 24-hour period, except for flood control, failures, etc. This ramping criteria is expected to minimize or eliminate impacts to steelhead and spring-run chinook fry and juveniles from stranding in areas below the Thermalito Afterbay. Flood control operations may result in rapid and large flow fluctuations within the low flow channel and the river below the Afterbay Outlet. Depending on the magnitude and/or duration of these flow fluctuations, there is a potential for fry and juvenile steelhead to become stranded. Flow fluctuations for flood control operations in the past have resulted in the stranding of juvenile salmon in broad shallow pools on the floodplain near Nelson Slough (CALFED ERP vol. 2, 1999) and potentially in the Robinson gravel pit.

Chinook salmon emigration studies in the Feather River from 1995 through 1998 have incidentally captured steelhead young-of-year and yearlings. Young-of-year were captured from March through June, while yearlings were captured January through June. Steelhead were not captured during the period between October and December, but researchers speculated that the sampling gear may not be able to detect their presence during this time rather than their apparent absence (DWR1999a, DWR 1999b, DWR 1999c). Based on these results and steelhead emigration patterns in the Sacramento River, steelhead juveniles and smolts are expected to emigrate from the Feather River to the lower Sacramento River and Delta from December through March. Predicted flows in the Feather River are expected to provide adequate depths and velocities for steelhead rearing and emigration. Predicted temperatures in the Feather River are expected to be within, or below, the preferred range for steelhead rearing and emigration

Results from the Feather River chinook salmon emigration studies indicate virtually all spring-run chinook juveniles in the Feather River exit as sub-yearlings. Emigration of chinook young-of-year begins immediately following emergence in late November, peaks in January or February, and continues through June (DWR 1999a, DWR 1999b, DWR 1999c). Predicted flow conditions in the Feather River from December 1999, through March 2000, are expected to provide adequate depths and velocities for the rearing and emigration of spring-run chinook salmon juveniles. Predicted water temperatures in the Feather River from December 1999, through March 2000, are expected to be within, or below, the preferred range for rearing and emigration of spring-run chinook salmon juveniles.

Sacramento-San Joaquin Delta

During the period from December through March, the Delta provides habitat for steelhead by (1) serving as a migration corridor for upstream migrating adults returning to freshwater to spawn; (2) serving as a migration corridor for downstream migrating juveniles to the ocean; and (3) it may provide short-term rearing habitat for juveniles as they move downstream towards the ocean. For spring-run chinook salmon the Delta also serves these three purposes during the period between December and March, but most adult upstream migrants would be expected to pass through the Delta after March 31.

From December 1999, through March 2000, Reclamation and DWR propose to operate the Delta export pumps and Delta Cross Channel gates in compliance with SWRCB permits, existing biological opinions for winter-run chinook salmon and delta smelt, the 1995 Bay-Delta Water

Quality Control Plan (D-1641), and all CVPIA AFRP (b)(2) Delta actions. Recent Delta export operations under the 1995 Water Quality Control Plan and AFRP actions have shifted pumping from the spring months to the fall and winter period. Based on the October 1999 CVP/SWP operations forecast (dated November 3, 1999), the export pumps will be operated at or near the maximum export/inflow (E/I) standard between December 1999, and March 2000, in the 90% exceedence forecast and levels significantly below the maximum E/I standard in the 50% exceedence forecast.

Adult Migration

From December through March, steelhead adults and the early portion of the adult spring-run chinook migration will be passing through the Delta for access to upstream spawning areas in the Sacramento and San Joaquin basins. Changes in Delta hydraulics from CVP and SWP export pumping in the south Delta are expected to affect the ability of adult steelhead and spring-run chinook to successfully "home" on their natal streams. CVP and SWP export pumping alters Delta hydraulics by reducing total Delta outflows by as much as 14,000 cfs and altering net flows in several central and south Delta channels. Steelhead and spring-run chinook adults destined for the Sacramento Basin and the Mokelumne River may experience some minor disruptions during passage through the Delta by straying temporarily off-course in north and central Delta waterways. However, closure of the Delta Cross Channel gates during this period will minimize diversion of Sacramento River water into the Central Delta and improve attraction flows in the mainstem. In addition, export curtailments in February and March to comply with the 35% E/I standard will significantly improve hydraulic conditions in Delta waterways by providing a more natural (westward) flow pattern.

In the south Delta, adult steelhead bound for the Stanislaus River could have difficulty detecting attraction flows to the lower San Joaquin River. As proposed, combined CVP and SWP export rates will significantly exceed San Joaquin River flow at Vernalis. Upstream passage of adult steelhead destined for the Stanislaus River may be delayed by export operations. In the worst case, some adult steelhead may not find the lower San Joaquin River and "stray" into one of the Eastside streams, which include the Cosumnes, Mokelumne, and Calaveras rivers. The successful spawning and ultimate contribution to natural production of these "strays" is uncertain. Concerns about attraction of adult salmon to their home streams from excessive CVP and SWP exports have been expressed by Delta fisheries researchers (Hallock et al. 1970), but impacts have not been documented to date.

Fry, Juveniles, and Smolts

Steelhead juveniles are expected to enter the Delta beginning in December and continuing through March. The majority of steelhead arriving in the Delta will be smolts and are expected to pass relatively quickly through the Delta on their way to the ocean. Most steelhead smolts are 2-year old fish ranging in size from 200 to 300 mm in length. These fish are relatively large and, thus, have good swimming ability to avoid predators and overcome unnatural (reverse) flow patterns in Delta waterways.

Spring-run chinook salmon yearling smolts will be migrating through the Delta from November through March with peak migration occurring in December or January. This emigration of spring-run chinook yearlings is thought to be primarily smolts which pass relatively quickly through the Delta on their way to the ocean. Most yearling spring-run are expected to range in size from 70 to 150 mm in length. These fish are considerably larger than the sub-yearling juvenile spring-run chinook that emigrate during the spring months, but they are smaller than most steelhead smolts.

Some young-of-the-year spring-run chinook salmon will be emigrating from the upper Sacramento Basin to the lower river and Delta during December through March. The extent of the young-of-the-year population which enters the Delta during this period, depends on their natal stream and specific hydrologic conditions. For example, the bulk of the juvenile production in Butte and Big Chico creeks is thought to emigrate as young-of-the-year from their natal tributaries in December and January (DFG 1998). Increases in streamflow and/or turbidity is thought to stimulate emigration.

As presented above for adult steelhead and spring-run chinook, changes in Delta hydraulic conditions associated with CVP and SWP export pumping inhibit the function of Delta waterways as migration corridors. Rearing habitat for juveniles and smolts is also adversely affected. Central and southern Delta channels have become conduits for carrying water to the CVP and SWP export pumping facilities. Export pumping rates proposed under both the 50% and 90% forecasts, and particularly under the 90% exceedence forecast, will create unnatural flow conditions in the central and south Delta. Net flows during December and January will generally be eastward instead of westward in the lower San Joaquin River near Jersey Point (commonly referred to as reverse flows). North of the CVP and SWP Delta pumping plants, net flows in Old and Middle rivers will be southward instead of northward. As a result of these changes in hydraulic conditions, some steelhead and spring-run chinook smolts will be diverted from their primary rearing and migration corridors. Many individuals will arrive at the CVP and SWP fish salvage facilities while others are expected to be lost en route. Indirect losses are expected to result from entrainment in small unscreened water diversions, predation, food supply limitations, and poor water quality (DFG 1998). During February and March, export curtailments to comply with the 35% E/I standard will significantly improve hydraulic conditions in Delta waterways and potential adverse effects are greatly diminished.

With the Delta Cross Channel gates closed, approximately 70 to 80% of the steelhead and spring-run chinook salmon juveniles migrating downstream in the Sacramento River are expected to remain in the Sacramento River where they are less subject to the adverse effects related to CVP and SWP Delta export pumping. The remaining 20 to 30% are expected to be transported in direct proportion with the diversion of Sacramento River flow into Georgiana Slough. If the Delta Cross Channel gates are opened for water quality improvements or other purposes, a significantly greater proportion of Sacramento River flow and juvenile fish will be diverted into the Central Delta.

Several years of fisheries investigations conducted by FWS indicate that the survival of salmon smolts in Georgiana Slough and the Central Delta is significantly reduced when compared to the survival rate for fish that remained in the Sacramento River. Investigations conducted since 1993 with late-fall run chinook salmon during December and January are probably the most applicable to emigrating steelhead and spring-run chinook yearlings in the Delta. These survival studies were conducted by releasing one group of marked hatchery-produced salmon juveniles (CWT and adipose fin clip) into Georgiana Slough while a second group is released into the lower Sacramento River. FWS results have repeatedly indicated that juvenile salmon released directly into the Sacramento River while the DCC gates are closed survive, on average, eight times greater than those released into the central Delta via Georgiana Slough (DFG 1998).

The results of these studies clearly demonstrate that juvenile salmon, and probably steelhead, are adversely affected by deleterious factors encountered in the central Delta. CVP and SWP export operations are expected to contribute to these deleterious factors through altered flow patterns in central and south Delta channels. Under the 90% exceedence forecast, flow patterns are altered to a greater degree and expected to result in a higher level of impact to emigrating steelhead and spring-run yearling smolts.

Juvenile steelhead and spring-run chinook are expected to be directly entrained at the CVP's Tracy Fish Collection Facility and the SWP's Skinner Fish Protection Facility. Mortalities are expected to occur due to predation within Clifton Court Forebay (SWP only), entrainment through the primary and secondary louvers, and stress associated with handling and transportation.

The proposed AFRP (b)(2) Delta actions for December and January are expected to reduce impacts to emigrating steelhead and spring-run chinook smolts in the Delta. These (b)(2) actions are designed to increase the survival of yearling spring-run chinook salmon by reducing export levels at the CVP's Tracy Pumping Plant and potentially the SWP Banks Pumping Plant when Delta fisheries monitoring detects periods of increased vulnerability. Past fisheries monitoring efforts and Delta fish salvage records indicate juvenile spring-run chinook salmon and steelhead presence in the Delta is often episodic during December and January. Carefully timed periods of export curtailments are expected to improve Delta hydraulics and improve flow conditions during the (b)(2) action for emigrating smolts to successfully pass through the Delta to San Francisco Bay.

In addition to the AFRP (b)(2) Delta action for December and January, the CVP and SWP will implement the Sacramento River Spring-run Chinook Protection Plan. Through increased fisheries monitoring and close scrutiny of fish salvage results, the Spring-run Protection Plan will track potential losses of yearling spring-run chinook with marked late-fall run chinook as surrogates. It is expected that through the monitoring of surrogate fish losses and the utilization of the "yellow light" and "red light" indicators at 0.5% and 1.0 %, respectively, losses of wild spring-run chinook yearlings and steelhead originating from the Sacramento River Basin will not be lost at rates greater than that of the surrogates.

Suisun Marsh Salinity Control Structure

Recent modifications to the flashboards at the Suisun Marsh Salinity Control Structure (SMSCS) were designed to improve passage of adult salmon and steelhead when the facility is operated. Under both forecasts, DWR proposes to operate the gates from December through March.

Evaluation of upstream salmon passage is currently underway. The infrequent occurrence of steelhead in Suisun Marsh (DWR and Reclamation 1999) and the agility of adult steelhead suggests the operation of the SMSCS structure is unlikely to impede passage to upstream spawning areas. For adult spring-run chinook salmon, flashboard modifications are likely to reduce or eliminate the potential for passage delays. DWR and DFG study results will be available in early 2000 to determine the full effectiveness of the passage improvement modifications.

Rock Slough

During the period of December 1999, through March 2000, operation of the Rock Slough intake at the Contra Costa Canal is expected to entrain some juvenile steelhead and spring-run chinook salmon. During the period of 1994 through 1996, entrainment monitoring conducted by the CDFG estimated from 52 to 96 steelhead juveniles were lost per year (DWR and Reclamation 1999). Additional loss may have occurred through predation near the dead-end slough at the canal's intake. CDFG estimated total chinook entrainment losses per year ranged from 262-642 between 1994 and 1996 (DWR and Reclamation 1999). Specific loss estimates for spring-run chinook are not available, but probably represent less than 10% of total chinook losses considering the abundance of fall-run chinook fry and juveniles in the Delta during the spring months. Additional losses of steelhead and spring-run chinook to predation are also likely to occur in the canal and in the vicinity of the Rock Slough intake.

SWP Delta Pumping Plant Fish Protection Agreement (4-Pumps Agreement)

Pursuant to the SWP's 4-Pumps Agreement, three projects which benefit spring-run chinook salmon have been implemented or partially funded by DWR[2]. Although the 4-Pumps Agreement was intended to address and offset only direct losses of chinook salmon and other species caused by the SWP Delta Pumping Plant, certain projects implemented by or partially funded through the 4-Pumps Agreement create benefits that mitigate not only direct, but also indirect, adverse effects to spring-run chinook salmon that are caused by SWP operations during December 1,

[2]Based on supplemental information regarding DWR's program to mitigate the impacts of SWP operations in the Delta, including estimates of direct and indirect losses of spring-run chinook salmon smolts in the Delta from 1996 through 1998 and predicted annual spring-run chinook benefits in smolt equivalents, DWR asserts that these projects provide quantifiable benefits to spring-run chinook salmon and have more than replaced the spring-run losses resulting from the SWP's Delta operations. Although DFG disagrees with specific assumptions and calculations used by DWR in its analysis, DFG concurs based on its own analysis that for the period covered by this biological opinion, these projects that are currently implemented provide benefits that likely mitigate both direct and indirect effects to spring-run chinook salmon by SWP operations.

1999, through March 31, 2000. These projects are: (1) increased overtime wages for DFG wardens, (2) funds to cover over-budget costs of the Durham Mutual/Parrot Phelan Screen and Ladders project on Butte Creek, and (3) Mill Creek Water Exchange Program.

The 4-Pumps Agreement funds two enhanced enforcement programs throughout the range of Central Valley spring-run chinook and Central Valley steelhead. Through the provision of overtime wages for DFG wardens, the Spring-run Salmon Increased Protection Project allows for increased focus on poaching of adult chinook salmon from Sacramento River tributaries. Through the Delta-Bay Enhanced Enforcement Program, a team of ten wardens focus their enforcement efforts on salmon, steelhead, and other species of concern. These two enhanced enforcement programs, in combination with additional concern and attention from local landowners and watershed groups on the Sacramento River tributaries which support spring-run chinook salmon summer holding habitat, has likely reduced the amount of poaching in these areas.

The provisions of funds to cover over-budget costs for the Durham Mutual/Parrot Phelan Screen and Ladders project expedited completion of the construction phase of this project. Benefits attained from these funds accrued during 1996 by ensuring the construction of the project was completed during 1995. The project continues to benefit salmon and steelhead by facilitating upstream passage of adult spawners and downstream passage of juveniles.

The Mill Creek Water Exchange project is designed to provide for new wells that enable irrigators to switch from streamflow to groundwater, thus leaving water in Mill Creek during critical migration periods. An agreement between Los Molinos Mutual Water Company (LMMWC) , DFG, and DWR allows DWR to pump groundwater from two wells into the LMMWC canals in exchange for the water used from the LMMWC water right. Although the Mill Creek Water Exchange project was initiated in 1990 and the agreement provides for a well capacity of 25 cfs, only 12 cfs has been developed to date (Orange Cover Irrigation District 1999). In addition, it has been determined that a base flow of greater than 25 cfs is needed during the April through June period for upstream passage of adult spring-run chinook in Mill Creek (Reclamation and Orange Cover Irrigation District 1999). In some years, water diversions from the creek are curtailed by amounts sufficient to provide for passage of upstream migrating adult spring-run chinook salmon and downstream migrating juvenile steelhead and spring-run chinook. However, the current arrangement does not ensure adequate flows conditions will be maintained in all years.

Designated Critical Habitat

Reclamation and DWR's proposed operation of the CVP and SWP is likely to result in beneficial and adverse effects to designated critical habitat for Central Valley spring-run chinook and Central Valley steelhead during the period between December 1, 1999, and March 31, 2000. Critical habitat consists of the water, substrate, and adjacent riparian zone of accessible estuarine and riverine reaches.

Anticipated effects to critical habitat in upstream areas consist primarily of changes in the magnitude and duration of peak flows below CVP and SWP reservoirs. High flow events during flood control operations may inundate stream-side gravel bars and benches. Flooding of these areas may result in stranding of juvenile fish, but can also provide juvenile salmonids access to emergent vegetation and productive near-shore habitat for foraging. Stabilization of flows and tapering of peak flood events may improve conditions for spawning and incubation through reduction of scouring flow events.

In the Delta, CVP and SWP export pumping alters Delta hydraulics by reducing total Delta outflows by as much as 14,000 cfs and altering net flows in several central and south Delta channels. These changes in Delta flow patterns can adversely affect the ability of adult steelhead and spring-run chinook to successfully "home" on their natal Central Valley streams. For juvenile fish, changes in Delta flow patterns result in some steelhead and spring-run chinook smolts diverted from their primary rearing and migration corridors towards the CVP and SWP export pumps in the south Delta. The magnitude of impact to Delta flow and habitat conditions is dependent on a variety of factors including: 1) the level of exports in relation to the amount of incoming flows from the Sacramento River and the San Joaquin River, 2) amount of agricultural returns into the system, and 3) tidal cycles. The AFRP (b)(2) Delta actions and the Sacramento River Spring-run Chinook Protection Plan are expected to help minimize adverse affects on Delta net flow conditions through carefully timed periods of export curtailments when significant numbers of salmonid smolts are emigrating through the Delta to San Francisco Bay.

The impacts described above are generally limited to the period of operation covered under this biological opinion (December 1, 1999, through March 31, 2000) and are not expected to result in permanent impacts to or loss of designated critical habitat for these species. Other impacts are expected to occur that may result in long-term impacts to critical habitat. These additional impacts are primarily upstream and include the increased deposition of fine sediments in spawning gravels, decreased recruitment of spawning gravels, reduced transport of large woody debris, and encroachment of riparian and non-endemic vegetation into spawning and rearing areas resulting in reduced available habitat (NMFS 1996).

Synthesis of Effects

Based on the effects analysis, the alteration of the natural hydrological cycle due to CVP/SWP reservoir operations has the potential to adversely affect incubating and juvenile lifestages of steelhead and spring-run chinook salmon in the Sacramento River downstream of Shasta Dam, Clear Creek downstream of Whiskeytown Dam, and the Feather River downstream of Oroville Dam and may adversely affect incubating and juvenile lifestages of steelhead in the American River downstream of Folsom Dam, and the Stanislaus River downstream of New Melones Dam. The unnatural flow patterns created by the operation of the Delta Cross Channel and by the CVP/SWP export facilities have the potential to adversely affect steelhead and spring-run chinook salmon adult upstream migrants and juvenile downstream migrants within the Delta. In addition, direct entrainment of juvenile and adult steelhead and juvenile spring-run chinook may occur in the Delta at the CVP/SWP export facilities, as well as at the Rock Slough pumping plant. As mentioned previously, the potential amount and extent of adverse effects due to reservoir and export facility operations are difficult to predict because they are dependent on a variety of factors.

Reservoir operations. The potential for reservoir operations to result in adverse effects such as redd scouring or juvenile stranding is dependent on precipitation patterns during the winter and spring months. Heavy rainfall is likely to trigger flood control operations at Central Valley reservoirs and result in short-term high flow events in the upper Sacramento River, Clear Creek, Feather River, American River and/or Stanislaus River. Adverse effects due to flood control operations will be difficult to detect because any dead or injured specimens will be within the gravel substrate of the streambed. In addition, the amount and extent of adverse effects to steelhead and/or spring-run is difficult to predict and is dependent on a number of factors including: 1) the number of spawning adults that contribute to juvenile production in each basin which fluctuates between years, 2) the location of spawning habitat used in each particular reach, 3) the timing and duration of the spawning period (i.e., timing occurs early in the potential spawning timeframe versus late in the spawning season; heavy spawning activity occurs over a few weeks versus low spawning activity protracted over several months), 4) duration of the incubation period after spawning which is dependent on a variety of factors including water temperatures, 5) the occurrence of flood operations in relation to the occurrence of the various lifestages (i.e., occurs when few individuals are present or when most of the year's broodstock are present), and 6) the magnitude and duration of the flood operation.

Delta operations. Adverse effects to spring-run chinook and steelhead resulting from altered flow patterns created by the operation of the Delta Cross Channel and the CVP/SWP export facilities are difficult to detect and quantify. However, mark-recapture studies of juvenile salmon suggest that the survival of spring-run chinook yearlings and steelhead smolts is reduced when fish are diverted from the mainstem Sacramento River into the Central Delta. Reduced survival is likely a result of degraded habitat conditions in central and southern Delta waterways, increased residence time, predation, length of migration route, reverse flows, altered salinity gradient, adverse water temperatures, contaminants, and food supply limitations (DFG 1998).

Adverse effects associated with entrainment at the CVP/SWP export facilities are more easily quantified. Direct losses of spring-run chinook yearlings can be quantified at the Tracy and Skinner fish facilities based on observations of salvaged fish. With adherence to the CALFED Operations Group Spring-run Chinook Salmon Protection Plan, it is anticipated that the incidental take of juvenile spring-run chinook will not exceed 1 percent of the population. Coded-wire-tagged late fall-run chinook from the Coleman National Fish Hatchery will serve as a surrogate for losses of Central Valley spring-run chinook yearlings because juvenile spring-run chinook salmon are not readily distinguishable from other Central Valley chinook races in the Delta and there is no juvenile production estimate available for Central Valley spring-run chinook. These late fall-run chinook serve as an appropriate surrogate for spring-run chinook salmon losses, because they begin their emigration and smoltification passage through the Delta at approximately the same time and size as wild spring-run chinook. Direct losses of coded-wire-tagged juvenile late fall-run chinook are expected to occur at the same rate as wild spring-run chinook salmon. Therefore, conditions which result in the loss of 1 percent of the late fall-run chinook are likely to have resulted in the loss of 1 percent of the spring-run chinook salmon population.

Entrainment of sub-yearling spring-run chinook salmon is also expected in the Delta between December and March. Due to their overlap in size with fall-run chinook salmon, young-of-the-year spring-run chinook can not be identified according to a size criteria. Therefore, direct losses of young-of-the-year spring-run chinook can not be monitored through observations of salvaged fish nor can direct losses be quantified. However, the number of sub-yearling spring-run chinook is likely to be low due prior to March 31, 2000, because the majority of sub-yearling spring-run chinook emigration through the Delta occurs in April, May, and June.

Although entrainment of juvenile and adult steelhead will be monitored through the fish salvage operations at the Tracy and Skinner fish facilities, direct loss estimates for steelhead are not available because the estimators for losses to predation in Clifton Court Forebay, predation at Tracy fish facility, and entrainment through the primary and secondary Tracy and Skinner louver systems were developed from chinook salmon research. Existing information regarding steelhead predation losses and louver screening efficiency is insufficient to generate similar loss estimators for steelhead. However, the level of impact to steelhead smolts can be monitored from salvage estimates in prior years. Based on observations between 1993, and 1999, juvenile steelhead salvage (collected and released) ranged from approximately 300 to 4,300 fish during the period between December and March.

Additional adverse effects to juvenile steelhead and spring-run chinook may occur as a result of the operation of the Rock Slough intake of the Contra Costa Canal. Based on historical entrainment numbers at the Rock Slough Intake, anywhere between 30 to100 juvenile steelhead and 20 to 70 juvenile spring-run chinook may be entrained in the Contra Costa Canal. These numbers represent an extremely low percentage of the overall steelhead and spring-run chinook populations.

Impacts on ESU survival and potential for recovery.

Central Valley Steelhead. According to McEwan and Jackson (1996), the annual run size for the Central Valley steelhead ESU in 1991-92 was probably less than 10,000 fish based on RBDD counts, hatchery returns and past spawning surveys. At present, wild steelhead stocks appear to be mostly confined to upper Sacramento River tributaries such as Antelope, Deer, and Mill creeks and the Yuba River (McEwan and Jackson 1996). Naturally spawning populations are also known to occur in Butte Creek, and the upper Sacramento, Feather, American, Mokelumne, and Stanislaus rivers (CALFED 1999). However, the presence of naturally spawning populations appears to correlate well with the presence of fisheries monitoring programs, and recent implementation of new monitoring efforts has found steelhead in streams previously thought not to contain a population, such as Auburn Ravine, Dry Creek, and the Stanislaus River. It is possible that other naturally spawning populations exist in Central Valley streams, but are undetected due to lack of monitoring or research programs (IEP Steelhead Project Work Team

1999).

For steelhead within the Central Valley, there is limited to no data available for population estimates within any individual tributaries including those with CVP/SWP facilities, however, natural spawning estimates for the upper Sacramento River and American River were calculated in the early 1990's. In the upper Sacramento River, estimates for the period from 1967 to 1991 averaged 3,465 adults, based on RBDD counts that were corrected for harvest. This estimate includes adults that would spawn in areas of the upper mainstem Sacramento River as well as suitable tributaries above RBDD including Clear Creek. In the American River, run sizes of 305; 1,462; and 255 were estimated to have occurred for the 90/91 through 92/93 seasons, based on escapement counts at the hatchery that were corrected for harvest (McEwan and Jackson 1996). In the Stanislaus River, a small, remnant run is recognized to exist based on occasional observations of adults and downstream juvenile migrants by anglers and fishery biologists, respectively. Besides naturally spawning populations occurring in streams with CVP/SWP facilities, hatchery production occurs on the Feather and American Rivers and each of the hatcheries produce 400,000 steelhead yearlings annually to mitigate for Oroville and Folsom dams, respectively.

Although accurate population estimates for steelhead within each basin are not available and the exact number of individual steelhead within the action area that will experience adverse effects due to the implementation of CVP/SWP operations is difficult to quantify, NMFS anticipates that the amount of steelhead affected will be small relative to the Central Valley population as a whole for several reasons. First, steelhead spawning and rearing in CVP/SWP tributaries comprise only 5 streams of 15 to 20 major steelhead spawning streams within the overall ESU. Second, the operations of each reservoir facility will not adversely affect steelhead to the same degree and will depend on precipitation patterns and the factors mentioned in the synthesis of effects section above. And last, steelhead typically outmigrate through the Delta during periods when protective measures for spring-run and winter-run chinook salmon, as well as for Delta smelt (a USFWS listed species), are implemented by the CVP/SWP Delta facilities and will likely receive similar protection.

Spring-run Chinook Salmon. Natural spawning populations of Central Valley spring-run chinook salmon are currently restricted to accessible reaches in the upper Sacramento River, Antelope Creek, Battle Creek, Beegum Creek, Big Chico Creek, Butte Creek, Clear Creek, Deer Creek, Feather River, Mill Creek, and Yuba River (DFG 1998; FWS, unpublished data). With the exception of Butte Creek and the Feather River, these populations are relatively small ranging from a few fish to several hundred. Butte Creek returns in 1998 and 1999 numbered approximately 20,000 and 3,600, respectively (DFG unpublished data). On the Feather River, significant numbers of spring-run chinook, as identified by run timing, return to the Feather River Hatchery. However, coded-wire-tag information from these hatchery returns indicates substantial introgression has occurred between fall-run and spring-run chinook populations in the Feather River due to hatchery practices.

In the mainstem Sacramento River and Feather River, the extent of spring-run chinook spawning is unknown but is anticipated to be very low based on spawning surveys. In Clear Creek, 35+ adult chinook were identified by FWS and DFG during the summer of 1999 between Whiskeytown Dam and the confluence with the Sacramento River; all but one were observed below McCormick-Saeltzer Dam. Phenotypic indicators suggest most, if not all, of the adult chinook salmon observed in Clear Creek during the 1999 surveys were spring-run chinook salmon. Reclamation's temperature control efforts in September 1999, avoided significant losses of incubating spring-run chinook. However, the resulting temperatures of 57°F to 60°F during September may have reduced the survival of some eggs and pre-emergent spring-run chinook in Clear Creek. Based on observations of emergent fry in November, these temperatures also accelerated the incubation period for these fish and it is anticipated that many of the spring-run chinook emerged from the gravels prior to December.

Although accurate population estimates for spring-run chinook salmon within each basin are not available and the exact number of individual spring-run chinook within the action area that will experience adverse effects due to the implementation of CVP/SWP operations is difficult to quantify, NMFS anticipates that the amount of spring-run chinook affected will be small relative to the Central Valley population as a whole for several reasons. First, spring-run chinook spawning and rearing in CVP/SWP tributaries comprise only 3 streams of approximately 10 to 12 spring-run chinook spawning and rearing streams within the overall ESU. Second, the operations of each reservoir facility will not adversely affect spring-run chinook to the same degree and will depend on precipitation patterns and the factors mentioned in the synthesis of effects section above. And last, the protective measures for spring-run chinook that will be implemented according to the AFRP (b)(2) Delta actions and the Sacramento River Spring-run Chinook Protection Plan are expected to minimize adverse affects in the Delta.

Overall Impacts

Although the exact number of individual steelhead and spring-run chinook salmon within the action area that will experience adverse effects due to the implementation of these operations is difficult to quantify, NMFS anticipates that the amount of steelhead and spring-run chinook salmon affected will be small relative to the Central Valley population as a whole. Populations of Central Valley spring-run chinook and Central Valley steelhead within Deer Creek, Mill Creek, and several other Sacramento River tributaries will essentially be unaffected by upstream CVP and SWP reservoir operations. Below CVP and SWP reservoirs, flow conditions are predicted to provide adequate depths and velocities for spawning, rearing, and migration. Temperature conditions are predicted to be within the preferred range for spawning, egg incubation, juvenile rearing, and migration. Therefore, the level of incidental take resulting from CVP and SWP operations addressed in this Opinion is not expected to appreciably reduce the likelihood of survival and recovery of the CV steelhead and CV spring-run chinook salmon populations.

VI. CUMULATIVE EFFECTS

Cumulative effects include the effects of future State, tribal, local, or private actions that are reasonably certain to occur in the action area considered in this biological opinion. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the ESA.

Non-Federal actions that may affect the action area include State angling regulation changes, voluntary State or private sponsored habitat restoration activities, State hatchery practices, agricultural practices, water withdrawals/diversions, increased population growth, mining activities, and urbanization. State angling regulations are generally moving towards greater restrictions on sport fishing to protect listed fish species. Habitat restoration projects may have short-term negative effects associated with in-water construction work, but these effects are temporary, localized, and the outcome is a benefit to these listed species. State hatchery practices may have negative effects on naturally produced salmonids through genetic introgression, competition, and disease transmission resulting from hatchery introductions. Farming activities within or adjacent to the action area may have negative effects on Sacramento River water quality due to runoff laden with agricultural chemicals. Water withdrawals/diversions may result in entrainment of individuals into unscreened or improperly screened diversions, and may result in depleted river flows that are necessary for migration, spawning, rearing, flushing of sediment from spawning gravels, gravel recruitment and transport of large woody debris. Future urban development and mining operations in the action area may adversely affect water quality, riparian function, and stream productivity. Future land conservation and habitat restoration activities expected in the action area, such as those planned by the ongoing CALFED process, are anticipated to offset many of the adverse effects associated with these non-Federal actions.

VII. CONCLUSION

After reviewing the current status of the threatened Central Valley steelhead and Central Valley spring-run chinook salmon, the environmental baseline for the action area, the effects of the proposed operations for the CVP and SWP during December 1999 through March 2000, and cumulative effects, it is NMFS' biological opinion that CVP and SWP operations from December 1999 through March 2000, as proposed, are not likely to jeopardize the continued existence of the Central Valley steelhead, the Central Valley spring-run chinook salmon, or result in the destruction or adverse modification of their designated critical habitat.

Notwithstanding NMFS' conclusion that the CVP and SWP operations from December 1999 through March 2000, are not expected to jeopardize the continued existence of Central Valley steelhead and Central Valley spring-run chinook salmon, NMFS anticipates that some actions associated with these operations may result in incidental take of the species. Therefore, an incidental take statement is provided with this Biological Opinion for these actions.

INCIDENTAL TAKE STATEMENT

Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct. Harm is further defined to include significant habitat modification or degradation which actually kills or injures fish or wildlife by significantly impairing essential behavioral patterns, including breeding, spawning, rearing, migrating, feeding, or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and 7(o)(2), taking that is incidental to and not intended as part of the proposed action is not considered to be prohibited taking under the ESA provided that such taking is in compliance with this Incidental Take Statement.

Section 7 (b)(4) of the ESA requires that when a proposed agency action is found to be consistent with section 7(a)(2) of the ESA, and the proposed action may incidentally take individuals of a listed species, NMFS will issue a statement that specifies the impact of any incidental taking of endangered or threatened species. It also states that reasonable and prudent measures, and terms and conditions to implement the measures, be provided that are necessary to minimize such impacts. Under the terms and conditions of section 7(o)(2) and 7(b)(4), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the ESA provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement.

The measures described below are non-discretionary. They must be implemented by Reclamation and DWR so that they become binding conditions of any grant or permit issued to the applicant, as appropriate, for the exemption in section 7(o)(2) to apply. Reclamation and DWR have a continuing duty to regulate the activity covered in this incidental take statement. If Reclamation and/or DWR (1) fail to assume and implement the terms and conditions of the incidental take statement, and/or (2) fail to require the applicant to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to the permit or grant document, the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, Reclamation and DWR must report the progress of the action and its impact on the species to NMFS as specified in this incidental take statement (50 CFR §402.14(i)(3)).

This incidental take statement is applicable to all activities related to the operation of the Central Valley Project (CVP) and State Water Project (SWP) described in this opinion. Unless modified, this incidental take statement does not cover activities that are not described and assessed within this opinion. In addition, unless modified, this incidental take statement does not cover the facilities or activities of any CVP or SWP contractor, or the facilities or activities of parties to agreements with the U.S. that recognize a previous vested water right.

I. Amount or Extent of Take

The NMFS anticipates that threatened Central Valley steelhead and Central Valley spring-run chinook salmon will be taken as a result of this proposed action. The incidental take is expected to be in the form of death, injury, harm, capture, and collection. Death, injury, and harm to juvenile and adult steelhead and spring-run chinook salmon are anticipated from the depletion and storage of natural flows at CVP and SWP reservoirs. Reservoir operations are expected to significantly alter the natural hydrological cycle in the Sacramento River downstream of Shasta Dam, Clear Creek downstream of Whiskeytown Dam, the Feather River downstream of Oroville Dam, the American River downstream of Folsom Dam, and the Stanislaus River downstream of New Melones Dam.

Reservoir releases to downstream areas during flood control operations may result in the take of steelhead eggs and pre-emergent fry through the scouring of redds. The potential amount and extent of take of steelhead eggs and pre-emergent fry is difficult to predict, because it is directly dependent on precipitation patterns during the upcoming winter and spring months. Heavy rainfall is likely to trigger flood control operations at Central Valley reservoirs and result in short-term high flow events in the upper Sacramento River, Clear Creek, Feather River, American River and/or Stanislaus River. Extremely high flow events may scour steelhead redds and result in the injury and mortality of steelhead eggs and sac-fry. Dry conditions or moderate precipitation will not create high stream flow conditions and no take of steelhead eggs and pre-emergent fry through redd scour would occur. In addition, incidental take of steelhead due to flood control operations will be difficult to detect, because any dead or injured specimens will be within the gravel substrate of the streambed.

Flood control operations can also lead to the incidental take of fry and juvenile steelhead and spring-run chinook through stranding. Stranding may occur in areas that are not connected to the creek except during periods of high flows. Heavy rainfall is likely to trigger flood control operations at Central Valley reservoirs and result in short-term high flow events in the upper Sacramento River, Clear Creek, Feather River, American River and/or Stanislaus River. During periods of high flows, juvenile steelhead and spring-run chinook may enter into areas that become isolated from the creek once flows recede. If additional high flow events do not follow within a short period of time, these stranded fish may be lost to predation, lethal water temperature conditions, or dessication. Incidental take of fry and juvenile steelhead is anticipated if precipitation patterns result in flood control operations. However, the extent of stranding will be difficult to detect and quantify due to the large geographic area that will be affected and finding a dead or injured specimen is unlikely without a systematic survey immediately following the flood event. Take of adult steelhead is unlikely to occur as a result of flood control operations and no take of adult spring-run chinook salmon is anticipated.

Capture and collection of juvenile steelhead in the Stanislaus River by screw traps is anticipated through fisheries studies to evaluate New Melones Reservoir operations on anadromous salmonids. Based on past sampling by screw trap at the Oakdale sampling site, approximately 20 to 30 steelhead smolts and pre-smolts may be captured and released below the trapping site. Steelhead fry have not been captured in previous years and few, if any, are expected to be captured in the winter 2000 sampling season. Previous sampling experience with screw traps in the Stanislaus River indicates that all captured steelhead will be maintained in good physical condition and released unharmed back into the river. No take of adult steelhead in the Stanislaus

River fisheries investigations is anticipated.

In the Delta, death, injury, and harm to juvenile and adult steelhead and spring-run chinook are anticipated due to unnatural flow patterns created by the operation of the Delta Cross Channel and CVP/SWP export pumping. This take includes that incurred by salvage activities, predation associated with physical structures, losses due to entrainment at water diversions, and straying of adult upstream migrants. Additional take of juvenile steelhead and spring-run chinook is expected at Rock Slough intake at the Contra Costa Canal. Take through the capture and collection of juvenile and adult steelhead, and juvenile spring-run chinook at the Tracy and Skinner Fish Facilities is anticipated. At the Suisun Marsh Salinity Control Structure take is anticipated from delays in upstream and downstream fish passage when the gates are tidally operated.

In the Delta, incidental take due to the operation of the Delta Cross Channel and export pumping plants is expected from both direct and indirect losses. Direct losses can be quantified at the Tracy and Skinner fish facilities based on observations of salvaged fish. Indirect losses, however, can not be easily quantified, because juvenile fish die as a result of altered flow patterns and the resulting exposure to degraded habitat conditions in the central Delta. Indirect losses of juvenile spring-run chinook and steelhead in the Delta are generally attributed to increased residence time, length of migration route, reverse flows, altered salinity gradient, predation, adverse water temperatures, contaminants, and food supply limitations (DFG 1998).

Although indirect losses in the Delta can not be quantified, direct losses of spring-run chinook yearlings and steelhead smolts will be monitored at the Tracy and Skinner fish facilities. Based on adherence to the CALFED Operations Group Spring-run Chinook Salmon Protection Plan, it is anticipated that the incidental take of juvenile spring-run chinook will not exceed 1 percent of the population. Coded-wire-tagged late fall-run chinook from the Coleman National Fish Hatchery will serve as a surrogate for losses of Central Valley spring-run chinook yearlings, because juvenile spring-run chinook salmon may not be distinguishable from other Central Valley chinook races in the Delta and there is no juvenile production estimate available for Central Valley spring-run chinook. These late fall-run chinook should serve as an appropriate surrogate for spring-run chinook salmon losses because NMFS expects that these fish, which begin their emigration and smoltification passage through the Delta at approximately the same time and size as wild spring-run chinook, will be taken at the same rate as wild spring-run chinook salmon. Therefore conditions which result in the loss of 1 percent of the late fall-run chinook are likely to have resulted in the loss of 1 percent of the spring-run chinook salmon population.

Take of young-of-the-year spring-run chinook salmon is expected in the Delta between December and March. Juvenile spring-run chinook arriving in the Delta as sub-yearlings will be subject to direct and indirect losses. Due to their overlap in size with fall-run chinook salmon, losses of young-of-the-year spring-run chinook can not be precisely quantified or monitored through observations of salvaged fish.

Take of juvenile steelhead will be monitored through the fish salvage operations at the Tracy and Skinner fish facilities. However, direct loss estimates for steelhead are not available, because estimators for losses to predation in Clifton Court Forebay, predation at Tracy fish facility, and entrainment through the primary and secondary Tracy and Skinner louver systems were developed from chinook salmon research. Existing information regarding steelhead predation losses and louver screening efficiency is not adequate to generate similar loss estimators for steelhead. However, the level of take of steelhead can be anticipated from salvage estimates in prior years. Based on observations between 1993, and 1999, juvenile steelhead salvage (collected and released) is expected to range from approximately 300 to 4,300 fish during the period between December 1999, and March 2000. At the Rock Slough, from 30 to 100 juvenile steelhead and 20 to 70 juvenile spring-run chinook may be taken through entrainment into the Contra Costa Canal.

Reclamation and DWR have proposed to operate CVP and SWP facilities in accordance with either plans, agreements, or specific criteria outlined in this biological opinion. Deviations from these plans, agreements, or criteria may result in adverse impacts to Central Valley spring-run chinook salmon and steelhead that have not been analyzed in this opinion. In this event, formal consultation shall be reinitiated immediately to analyze the effects to spring-run chinook salmon and steelhead and determine if the changes are likely to jeopardize these species or result in additional incidental take.

II. Effect of the Take

The effect of this action in the up river areas will consist of fish behavior modification, temporary loss of habitat value, and potential death or injury of juvenile steelhead and spring-run chinook as a result of streamflow fluctuations in the upper Sacramento River, Clear Creek, Feather River, American River, and Clear Creek. In the Sacramento-San Joaquin Delta, the effect of this action will alter fish behavior, result in modification of habitat value, and result in the death and injury of juvenile fish as a result of altered Delta flow patterns and direct loss at the Tracy and Skinner fish collection facilities.

In the accompanying biological opinion, NMFS determined that this level of anticipated take is not likely to result in jeopardy to the listed species or destruction or adverse modification of designated critical habitat.

III. Reasonable and Prudent Measures

NMFS believes the following reasonable and prudent measures are necessary and appropriate to minimize take of Central Valley steelhead and Central Valley spring-run chinook salmon:

1. Reclamation and DWR shall minimize the adverse effects of flow fluctuations associated with upstream reservoir operations on the incubating eggs, fry, and juvenile steelhead and spring-run chinook.

2. Reclamation and DWR shall gather information regarding the effects of flow fluctuations on fisheries downstream of CVP and SWP reservoirs, and develop long-term ramping criteria that will minimize these adverse effects.

3. Reclamation shall minimize the adverse effects associated with fisheries monitoring on steelhead in the Stanislaus River.

4. Reclamation shall minimize the adverse effects of Delta Cross Channel gate operations on juvenile steelhead and spring-run chinook salmon.

5. Reclamation and DWR shall minimize the adverse effects of Delta exports on juvenile steelhead and spring-run chinook salmon.

6. Reclamation and DWR shall collect additional data at the fish salvage collection facilities for improving facility operations and incidental take monitoring with regard to steelhead and spring-run chinook.

7. Reclamation and DWR shall continue to provide benefits to spring-run chinook and steelhead to mitigate the direct and indirect adverse effects of CVP and SWP operations on spring-run chinook salmon and steelhead.

IV. Terms and Conditions

Reclamation and DWR must comply or ensure compliance by their contractor(s) with the following terms and conditions, which implement the reasonable and prudent measures described above. These terms and conditions are non-discretionary.

1. Reclamation and DWR shall minimize the adverse effects of flow fluctuations associated with upstream reservoir operations on the incubating eggs, fry, and juvenile steelhead and spring-run chinook.

   a. Feather River - During periods outside of flood control operations and to the extent controllable during flood control operations, DWR shall ramp down releases to the low flow channel as presented in the table below:

Feather River Low-Flow Channel Releases (cfs)	Rate of Decrease (cfs)
5,000 to 3,501	1,000 per 24 hours
3,500 to 2,501	500 per 24 hours
2,500 to 600	200 per 24 hours

b. American River - During periods outside of flood control operations and to the extent controllable during flood control operations, Reclamation shall ramp down releases in the American River below Nimbus Dam as presented in the table below:

During any 24 hour period do not decrease Nimbus flows (measured in cfs) more than the ranges shown in column 1	Do not make individual Nimbus release decreases (measured in cfs) greater than values in column 2
Column 1 - Daily Rate of Change	Column 2 - Individual Rate of Change
20,000 to 16,000	1,000 - 1,500
16,000 to 13,000	1,000
13,000 to 11,000	500-800
11,000 to 9,500	500
9,500 to 8,000	500
8,000 to 7,000	300-350
7,000 to 6,000	300-350
6,000 to 5,500	250
5,500 to 5,000	250
Below 5,000 up to 500/24 hr.	50/hour

c. Stanislaus River - During periods outside of flood control operations and to the extent controllable during flood control operations, Reclamation shall ramp releases in the Stanislaus River below Goodwin Dam as presented in the table below:

Existing Release Level (cfs)	Rate of Increase (cfs)	Rate of Decrease (cfs)
at or above 4,000	1,000 per 2 hours	500 per 4 hours
2,000 to 3,999	500 per 2 hours	500 per 4 hours
500 to 1,999	250 per 2 hours	200 per 4 hours
300 to 499	100 per 2 hours	100 per 4 hours
150 to 299	75 per 2 hours	50 per 4 hours

d. Reclamation and DWR shall not reduce releases downstream of Keswick Dam, Whiskeytown Dam, Nimbus Dam, Oroville Dam, and/or Goodwin Dam to a monthly average flow below the levels identified in the October 1999 (dated November 3, 1999)

90 percent exceedence forecast without submission of a revised project description and reinitiation of consultation with NMFS.

2. Reclamation and DWR shall gather information regarding the effects of flow fluctuations on fisheries downstream of CVP and SWP reservoirs, and develop long-term ramping criteria that will minimize these adverse effects.

   a. Reclamation shall design and implement a monitoring program for direct counts of stranded juvenile salmonids and dewatered redds in Clear Creek and the Stanislaus River during the fall and winter of 2000/2001. The program shall include identification and evaluation of potential salmonid stranding areas. This information shall serve as a basis for establishing long-term ramping rate criteria specific for each stream. The monitoring proposal and schedule for implementation must be submitted to NMFS for review and approval by July 1, 2000. If appropriate, authorization for any incidental take associated with the implementation of these monitoring programs will be provided to Reclamation with NMFS review and approval of the study plans.

   b. DWR shall design and implement a monitoring program for direct counts of stranded juvenile salmonids and dewatered redds in the Feather River during the fall and winter of 2000/2001. The program shall include identification and evaluation of potential salmonid stranding areas. This information shall serve as a basis for establishing long-term ramping rate criteria specific for the Feather River, particularly the low flow channel. The monitoring proposal and schedule for implementation must be submitted to NMFS for review and approval by July 1, 2000. If appropriate, authorization for any incidental take associated with the implementation of these monitoring programs will be provided to DWR with NMFS review and approval of the study plans.

   c. Reclamation and DWR shall provide NMFS (Gary Stern, National Marine Fisheries Service, Southwest Region, Protected Resources Division, 777 Sonoma Avenue, Room 325, Santa Rosa, California 95404) the results of these ramping rate monitoring programs and a proposal for implementing the long-term ramping criteria by July 1, 2001.

3. Reclamation shall minimize the adverse effects associated with fisheries monitoring on steelhead in the Stanislaus River.

   a. At least one trained and qualified fisheries technician (minimum of 2 years experience with sampling and handling of juvenile anadromous salmonids) shall be onsite during each day of sampling throughout the duration of the fisheries monitoring program to insure full adherence to the sampling and handling protocols identified in the Stanislaus River Sampling Plan submitted by Reclamation on May 14, 1999.

   b. Reclamation or their authorized representative shall notify NMFS (contact: Gary Stern, 707-575-6060, fax 707-578-3435) by the next business day if one or more steelhead are killed or injured as a result of the Stanislaus River fisheries monitoring program. NMFS, in coordination with Reclamation, will review the activities resulting in lethal or harmful take to determine if additional protective measures are required. Subsequent notification must also be made in writing to NMFS (Gary Stern, National Marine Fisheries Service, Southwest Region, Protected Resources Division, 777 Sonoma Avenue, Room 325, Santa Rosa, California 95404) within five-days of noting dead or injured steelhead. The written notification shall include the date, time, and location of the carcass or injured specimen, a color photograph, cause of injury or death, and name and affiliation of the person who found the specimen.

c. Reclamation shall provide a written report regarding results of the winter and spring 2000 Stanislaus River fisheries monitoring studies to NMFS (Gary Stern, National Marine Fisheries Service, Southwest Region, Protected Resources Division, 777 Sonoma Avenue, Room 325, Santa Rosa, California 95404) by September 1, 2000. The report shall include: (1) the number of steelhead captured; (2) fork length; (3) condition (e.g., alive, injured, dead, and life stage characterization); (4) the number of steelhead released back into the river; and (5) other information collected (e.g., velocity, temperature, and turbidity measurements, etc). Life stage characterization guidelines are available in the Steelhead Life-Stage Assessment Protocol developed by the Interagency Ecological Program Steelhead Project Work Team (December 1998).

4. Reclamation shall minimize the adverse effects of Delta Cross Channel gate operations on juvenile steelhead and spring-run chinook salmon.

   a. During the period between December 1, 1999, and January 31, 2000, Reclamation shall operate the gates of the Delta Cross Channel (DCC) consistent with the CALFED Operations Group Spring-Run Chinook Salmon Protection Plan. Reclamation and NMFS, in coordination with the CALFED Data Assessment Team (DAT) will monitor water quality conditions within the Delta. Gate openings for water quality improvements shall be coordinated with NMFS (Gary Stern, 707-575-6060) and openings shall be minimized if fisheries monitoring results indicate juvenile chinook and steelhead are emigrating in the vicinity of the DCC.

   b. To address the potential competing objectives of water quality improvement and fisheries protection, Reclamation and DWR shall develop specific water quality criteria, operational rules, and decision making process for operation of the DCC gates during the period between November 1 and January 31. This effort shall include investigation of whether hydrodynamic models can be used to predict potential water quality problems and alternative operations scenarios for the DCC gates and the Delta export pumps. Draft water quality criteria, operational rules, and decision-making process shall be provided to NMFS for review and concurrence by September 1, 2000.

5. Reclamation and DWR shall minimize the adverse effects of Delta exports on juvenile steelhead and spring-run chinook salmon.

a. Based on observations of juvenile steelhead, juvenile spring-run size chinook salmon (70 mm to 150 mm), or late-fall chinook salmon surrogates (CWT fish from Coleman National Fish Hatchery) in (1) lower Sacramento River fisheries monitoring stations (Knight's Landing, Tisdale, City of Sacramento, beach seine program), (2) Delta fisheries monitoring stations (beach seine program, Chipps Island), or (3) Tracy or Skinner fish salvage facilities, Reclamation and DWR shall reduce CVP and SWP pumping levels to improve the survival of steelhead and spring-run chinook smolts in the Delta for periods extending from 5 to10 days. These export reductions to a combined CVP/SWP pumping rate of 4,000 to 10,000 cfs depending on Delta inflow conditions will be implemented on a flexible schedule between January 1, 2000 and March 31, 2000, and initiated at the recommendation of NMFS. The decision to implement these export curtailments, it's duration, and specific export level will be made by NMFS in coordination with Reclamation, DWR, and CALFED DAT. The NMFS will provide Reclamation and DWR, at minimum, 24 hours notice prior to the initiation of the target CVP/SWP export rates. NMFS will make every effort possible to combined these export curtailments with the currently proposed (b)(2) actions by FWS, but curtailments pursuant to this term and condition are not constrained by the Department of Interior's (b)(2) water budget.

b. Incidental take of yearling spring-run chinook salmon at the CVP and SWP Delta export facilities will be based on observations of CWT late-fall chinook salmon uniquely marked at Coleman National Fish Hatchery and released in the upper Sacramento Basin. Loss at the CVP and SWP Delta export facilities may not exceed 1% of any individual release group of CWT late fall chinook surrogates released in the upper Sacramento Basin (0.5% yellow light, 1% red light) from December 1, 1999, through March 31, 2000. Take will be calculated with the standard loss estimation procedures applicable at the respective fish collection facilities. At the 1% cumulative loss level (red light), Reclamation and DWR must take actions to avoid further loss and reinitiate consultation, if not already reinitiated at yellow light.

c. Incidental take of juvenile steelhead at the CVP and SWP Delta export facilities will be based of observations of unmarked steelhead at the Tracy and Skinner fish collection facilities. Cumulative salvage of unmarked juvenile steelhead (less than 350 mm) at the CVP and SWP combined may not exceed 3,400 fish (1,600 fish yellow light, 3,400 fish red light) from December 1, 1999, through March 31, 2000, based on the salvage estimation procedures described in the 4-Pumps Agreement at the respective collection facilities. If cumulative salvage of unmarked juvenile steelhead reaches 3,400 fish, Reclamation and DWR must take actions to avoid further collection and salvage of juvenile steelhead and reinitiate consultation, if not already reinitiated at yellow light.

6. Reclamation and DWR shall collect additional data at the fish salvage collection facilities for improving facility operations and incidental take monitoring with regard to steelhead and spring-run chinook.

a. Tissue samples from juvenile spring-run chinook salmon and steelhead at the Tracy and

Skinner fish collection facilities shall be collected for genetic analysis pursuant to the sampling protocols established by the IEP Salmon Genetics Project Work Team. Tissues shall be stored at the DFG tissue bank at Rancho Cordova for subsequent analysis by Bodega Marine Lab or similar lab approved by NMFS.

7. Reclamation and DWR shall continue to provide benefits to spring-run chinook and steelhead to mitigate the direct and indirect adverse effects of CVP and SWP operations on spring-run chinook salmon and steelhead.

   a. DWR shall continue to implement and/or fund projects pursuant to the 4-Pumps Agreement, including the three projects listed herein.

   b. Reclamation and DWR shall work with NMFS and DFG to implement and/or fund any other projects that Reclamation, DWR, DFG, and NMFS agree are necessary and appropriate to provide for the protection and/or recovery of Central Valley spring-run chinook salmon or steelhead.

   c. Reclamation and DWR shall work with NMFS and DFG to implement and/or fund any monitoring projects that Reclamation, DWR, DFG, and NMFS agree are necessary and appropriate to monitor incidental take levels or provide for the protection and/or recovery of Central Valley spring-run chinook salmon or steelhead.

CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the ESA directs federal agencies to utilize their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of endangered and threatened species. These "conservation recommendations" include discretionary measures that Reclamation and DWR can take to minimize or avoid adverse effects of a proposed action on a listed species or critical habitat or regarding the development of information. In addition to the terms and conditions of the Incidental Take Statement, the NMFS provides the following conservation recommendations that would reduce or avoid adverse impacts on the listed species:

1. Reclamation and DWR should support expanded anadromous salmonid monitoring programs throughout the Central Valley to improve our understanding of the life history of these listed species and improve the ability to provide fisheries protection through real-time management of CVP/SWP facilities.

2. Reclamation and DWR should support and promote aquatic and riparian habitat restoration downstream of CVP/SWP reservoirs with special emphasis upon the protection and restoration of shaded riverine aquatic cover and increase the existing stream meander zone.

REINITIATION OF CONSULTATION

This concludes formal consultation on the actions outlined in the biological opinion for the proposed operation of the CVP and SWP from December 1, 1999, through March 31, 2000. As provided in 50 CFR §402.16, reinitiation of formal consultation is required where discretionary Federal involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not previously considered in this opinion; (3) the action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, formal consultation shall be reinitiated immediately.

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